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Stomatopod Crustacea from Madagascar

By Raymond B. Manning

Chairman, Department of Invertebrate Zoology

This report is based on four different collections of stomatopods from the island of Madagascar (Malagasy Republic) and adjacent islands, including the Comoro Islands (Comores) and Ile Europa. Two of the collections were made available for study by M. Michel Pichon, Centre d'Océanographie et des Peches, Nosy Bé, Madagascar, and by A. G. Humes, Boston University, at that time the field chief on Madagascar for the International Indian Ocean Expedition. The third collection was made by several individuals under the auspices of the U.S. Program in Biology, International Indian Ocean Expedition; most of this series of specimens was collected by J. Rudloe while at Madagascar on assignment from the Smithsonian Institution Oceanographic Sorting Center. The fourth and most important collection was assembled by Alain Crosnier, now at the Centre d'Océanographie et des Peches, Pointe-Noire, Republic of the Congo, over a period of several years while working at the Centre d'Océanographie et des Peches (O.R.S.T.O.M.) in Nosy Bé, Madagascar.

Together, all of these materials indicate the richness of the stomatopod fauna of Madagascar. The collections reported herein include 28 species, approximately one-half of the stomatopods known from the western Indian Ocean, of which six species are described as new. All 10 species previously recorded from Madagascar are represented in the collections reported in this paper.

LITERATURE REVIEW.—Few species of stomatopods have been recorded from the island of Madagascar. Hoffmann (1874, 1874a), in papers on the crustaceans of Madagascar and neighboring islands, recorded the occurrence of four species from Mauritius and Reunion Islands but included no records from Madagascar. Lenz and Richters (1881) recorded two species, *L. maculata* (Fabricius) and *G. chiragra* (Fabricius), from Madagascar. Miers (1880), in the first review of the stomatopods, listed *Odontodactylus scyllarus* (Linnaeus) from Madagascar, and, in 1884, in a table of the distribution of species taken by the *Alert*, included Madagascar as a locality for *G. chiragra* (Fabricius) but mentioned no specimens from that locality in the text. Lenz (1910) reported three species from Madagascar: *Squilla nepa* Latreille, *Pseudosquilla ciliata* (Fabricius), and *Gonodactylus platysoma* Wood-Mason (as *G. chiragra* var. *acutus*).

Kemp (1913), in his survey of the Indo-West Pacific stomatopods, included no material from Madagascar, but he did include earlier references to material from there. Gravier (1920) included records for *S. nepa* and *G. chiragra* and in 1935 included records for *P. ciliata*, *G. chiragra*, and *G. demanii*. Also in his paper (1935) he erroneously noted that Lenz (1910) reported *G. fimbriatus* from Madagascar; Lenz only recorded that species from Zanzibar.

In an account of the stomatopods of West Africa, Monod (1925) figured the rostral plate of a specimen of *L. maculata* from Madagascar.

In 1938 Dollfus recorded Madagascar in his paragraph on the distribution of *Gonodactylus spinosus* Bigelow (as *G. De Mani* var. *spinosus*, p. 215), but no authenticated references to the occurrence of *G. spinosus* in Madagascar have come to my attention. A closely related species, *G. lanchesteri*, is recorded from Madagascar proper for the first time in the present report.

In 1941 Holthuis (p. 287) reidentified Hoffmann's specimens of *G. chiragra* from Reunion as *G. falcatus* (Forskål); in his section on material Holthuis recorded these specimens from Reunion but mentioned Madagascar in the text. Hoffmann mentioned only Reunion in his account.

Fourmanoir (1952, 1953) recorded *G. chiragra* from Madagascar and, in the second paper, gave observations on larval stages of that species and *S. nepa*. Poisson (1949), in a paper on the fauna of the *Cymodocea* biotope in Madagascar, noted the occurrence of *G. chiragra* there.

Humes (1965) recorded the occurrence of an *Acanthosquilla* from Nosy Bé that was a host for a new cyclopoid copepod, *Hemicyclops acanthosquillae*. The species of *Acanthosquilla* is described herein as *A. humesi*, new species.

Crosnier (1965) listed *Squilla nepa* and *S. raphidea* as occurring among catches of penaeid shrimps off Madagascar; the latter species is probably *Harpiosquilla harpax*.

In a review of the genus *Odontodactylus*, Manning (1967a) recorded the occurrence of two species, *O. japonicus* (de Haan) and *O. scyllarus* (Linnaeus); those records were based on three specimens reported below.

Manning (1967b) reported *Gonodactylus lanchesteri* Manning from the Comoro Islands; none of the seven species of *Gonodactylus* included in that study were from Madagascar proper.

Explanations and acknowledgments.—In general, synonymies are shortened, including only major references and some recent pertinent references; original citations, if made by Kemp (1913), are not repeated here. Where applicable, reference is made to Kemp's 1913 monograph of the Indo-West Pacific stomatopods.

In the section "Previous Records," earlier records of the occurrence of each species on Madagascar are summarized. For the species not illustrated herein, a figure to aid identification of the species is cited under the paragraph entitled "Illustration."

Measurements are given in millimeters (mm). In the material examined, the numerals following the number of specimens denote total length (TL), unless carapace length (CL) is specified; the latter is given only for damaged specimens. Total length is measured along the midline from the apex of the rostral plate to the apices of the submedian teeth of the telson. Carapace length is measured along the midline and does not include the rostral plate.

An abdominal spine formula of "submedian, 5–6; intermediate, 2–6; lateral, (1) 2–6; marginal, 1–5" indicates that the submedian carinae of the abdomen terminate in spines on the fifth and sixth somites, the intermediate carinae terminate in spines on the second to sixth somites, inclusive, the lateral carinae always terminate in spines on the second to somites, but these carinae occasionally are armed on the first somite, and all five marginal carinae terminate in spines. A parenthesis is used to indicate that a carina on a certain somite may be unarmed. A telson denticle formula of "5, 7–10, 1" indicates that on the telson margin, on each side of the midline, there are five submedian denticles, seven to 10 intermediate denticles, and one lateral denticle. The count of teeth on the dactylus of the claw always includes the terminal teeth.

The corneal index (CI) is calculated as carapace length/cornea width $\times$ 100.

Most specimens, including all holotypes, have been deposited in the Division of Crustacea, Smithsonian Institution (USNM); an identi-

fied set of specimens also has been deposited in the Muséum National d'Histoire Naturelle, Paris (MNHNP). The abbreviation IIOE identifies material obtained through the International Indian Ocean Expedition.

I thank Michel Pichon, Arthur G. Humes, and Alain Crosnier for making collections available for study; this report would not have been so complete without the large collection received from Crosnier. L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, Leiden, loaned a syntype of *Squilla harpax* de Haan, and Claude Michel, Mauritius Institute, allowed me to borrow the type of *Squilla juxtaoratoria* Ward.

The illustrations were made by my wife Lilly with the support of the Smithsonian Institution through its Research Awards program.

Clorida Eydoux and Souleyet, 1842

With the recent description of two species from India (Chhapgar and Sane, 1967) and a new species from Madagascar described herein, the genus *Clorida* now comprises 16 species, all of which occur in the Indo-West Pacific region. In view of the large number of species now placed in the genus, it is felt that the key to species presented below will be of some aid to other students of the group.

The key does not include *Squilla gibba* Nobili, 1903, a species aligned with *Clorida latreillei* Eydoux and Souleyet and its allies by previous workers. I have transferred Nobili's species to another genus in a paper now in press (Manning, 1967c).

Five species have been recorded from the Western Indian Ocean, including records given herein. *Clorida latreillei* has been recorded from southern Moçambique by Barnard (1926, 1950), and *C. microphthalma* (H. Milne-Edwards) has been recorded from Zanzibar by Jurich (1904) and Stephenson (1962). Either of these two species could occur off Madagascar.

Key to Species of *Clorida*

1. Mandibular palp absent 2
   Mandibular palp present 6
2. One rounded lobe present between spines of basal prolongation of uropod . 3
   Two rounded lobes present between spines of basal prolongation of uropod 5
3. Cornea broader than stalk; rostral plate with median carina.
   C. incerta (Hansen, 1926)
   Cornea not as broad as stalk; rostral plate lacking median carina 4
4. Lateral margins of intermediate teeth of telson with prominent denticles; inner margin of basal prolongation of uropod with 3–4 spines.
   C. denticauda (Chhapgar and Sane, 1967)

Lateral margins of intermediate teeth of telson not denticulate; inner margin of basal prolongation of uropod with 6–9 spines.
C. granti (Stephenson, 1953)

5. Sixth abdominal somite with supplementary spinules on posterior margin in addition to spines of dorsal carinae . . **C. mauiana** (Bigelow, 1931)
Sixth abdominal somite armed at most with spines of dorsal carinae.
C. fallax (Bouvier, 1914)

6. First 5 abdominal somites lacking submedian carinae 7
Submedian carinae present on one or more of the first 5 abdominal somites 12

7. Carapace lacking anterolateral spines . . **C. rotundicauda** (Miers, 1880)
Carapace with anterolateral spines 8

8. Postanal carina absent 9
Postanal carina present 10

9. Marginal carinae of abdomen unarmed . . . **C. choprai** (Tweedie, 1935)
Marginal carinae of at least second through fifth abdominal somites with posterior spines . . . . . **C. depressa** (Miers, 1880)

10. Cornea broader than stalk . . . . . **C. miersi,** new species
Cornea not as broad as stalk 11

11. Width of cornea about one-third eye length; lateral margin of carapace, posterior to anterolateral spine, straight or convex; rostral plate longer than broad . . . . . **C. microphthalma** (H. Milne-Edwards, 1837)
Width of cornea about one-half eye length; lateral margin of carapace, posterior to anterolateral spine, concave; rostral plate broader than long.
C. chlorida (Brooks, 1886)

12. No submedian carinae on first through third abdominal somites 13
All 6 abdominal somites with submedian carinae 14

13. Fifth and sixth abdominal somites with submedian carinae.
C. merguiensis (Tiwari and Biswas, 1952)
Fourth, fifth, and sixth abdominal somites with submedian carinae.
C. verrucosa (Hansen, 1926)

14. Lateral processes of sixth and seventh thoracic somites with posterolateral spine . . . . . **C. bombayensis** (Chhapgar and Sane, 1967)
Lateral processes of sixth and seventh thoracic somites unarmed 15

15. Ventral surface of telson smooth on either side of postanal carina.
C. latreillei Eydoux and Souleyet, 1842
Ventral surface of telson tuberculate and carinate on either side of postanal carina . . . . . **C. decorata** Wood-Mason, 1875

Clorida chlorida (Brooks, 1886)

FIGURE 1

Squilla chlorida Brooks, 1886, p. 40, pl. 2 (figs. 1–5).—Bigelow, 1894, p. 510 [key].—Kemp, 1913, p. 33.—Serène, 1952, fig. 12.

PREVIOUS RECORDS.—None.

MATERIAL.—1 juv., 12.1; Large Baie de Moramba, northwestern coast of Madagascar; dredge; 30 m; muddy sand; 1 March 1958; USNM. 1 ♂, 15.5; 1 ♀, 16.5; Banc de Pracel, western coast of Madagascar; dredge; 40 m; muddy sand; A. Crosnier; June 1959; USNM. 2 ♂, 19.5–32.0; 1 broken ♀, CL 9.6; same; dredge; 65 m; sand; A.

Crosnier; June 1959; MNHNP. 1 ♂, 38.2; Iles Mitsio, northwestern coast of Madagascar; trawl; 64 m; muddy sand; 28 July 1958; USNM.

Description.—Eye small, extending slightly beyond middle of first segment of antennular peduncle; stalk inflated, almost twice as long as broad; cornea small, bilobed, less than half as long as stalk; ocular scales rounded, fused along midline.

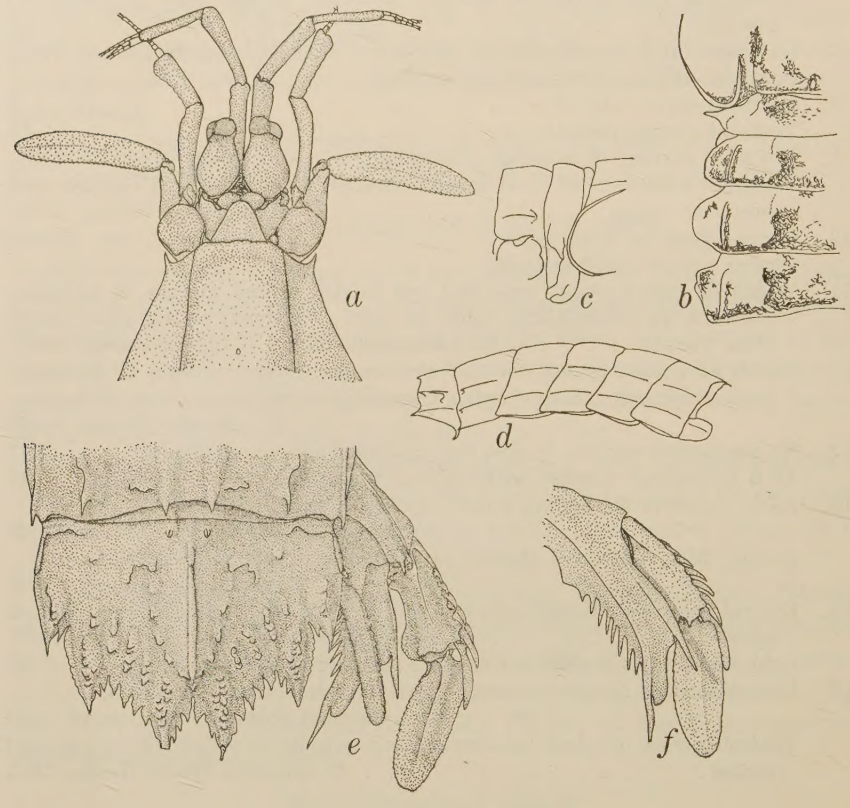

Figure 1.—*Clorida chlorida* (Brooks), male, TL 38.2, Iles Mitsio: *a*, anterior portion of body; *b*, lateral processes of exposed thoracic somites; *c*, outline of lateral processes of fifth and sixth thoracic somites, lateral view; *d*, outline of abdomen, lateral view; *e*, last abdominal somite, telson, and uropod; *f*, uropod, ventral view. (Setae omitted).

Antennular peduncle elongate, as long as carapace or nearly so; dorsal processes of antennular somite visible lateral to rostral plate as broad, sharp, anteriorly directed spines.

Antennal peduncle elongate, first segment extending well beyond eye; antennal scale slender, curved, over half as long as carapace.

Rostral plate broader than long, triangular, rounded anteriorly, without carinae.

Carapace strongly narrowed anteriorly, lateral margin concave, completely lacking median and intermediate carinae; posterior fourth of carapace usually with reflected marginal carinae only, traces of lateral carinae present or absent; posterior margin straight; anterolateral margins slope posterolaterally to strong anterolateral spines, which do not extend to base of rostral plate.

Raptorial claw stout; dactylus with 5 teeth, outer margin of dactylus flattened; dorsal ridge of carpus with single, low, blunt spine.

Mandibular palp and 4 epipods present.

Exposed thoracic somites without submedian carinae, last 3 somites with well-formed, unarmed intermediate carinae; lateral process of fifth somite a short sharp spine, directed laterally; fifth somite with blunt, tubercular, triangular or spiniform ventral projection on each side; lateral processes of next two somites not bilobed, rounded anterolaterally and posterolaterally, process of sixth somite more triangular than that of seventh; ventral keel of eighth somite a low, inconspicuous projection.

Abdomen broad, depressed, lacking submedian carinae on first 5 somites; abdominal carinae spined as follows: submedian, 6; intermediate, 5–6; lateral, (4) 5–6; marginal, (4) 5; sixth somite with sharp spine on each side in front of articulation of uropod.

Telson broader than long, with 3 pairs of sharp marginal teeth, submedians with movable apices; prelateral lobes formed dorsally, not noticeably projecting laterally; carinae of marginal teeth short, tuberculate dorsally; dorsal surface with short, U-shaped carinae, open posteriorly, at anterior end of line of 4 tubercles converging under posterior apex of median carina; 4 rows of tuberculate carinae present between submedian and intermediate teeth, outer row anterior to carina of intermediate tooth; single denticle present on surface anterior to outer row, at level of U-shaped carina; small spined tubercle present under spine of median carina; denticles sharp, spiniform, 3, 6–7, 1; ventral surface of telson with low postanal keel.

Outer margin of proximal segment of uropodal exopod with 7 slender, movable spines, last extending to midlength of distal segment; proximal segment of uropodal exopod with long dorsal carina; endopod slender, tapered, curved; basal prolongation with 6–8 slender spines on inner margin and broad, rounded lobe on outer margin of longer inner spine.

Color.—Carapace with 2 broad bands of dark pigment, gastric grooves dark; dorsal surface of merus dark; posterior margin of carapace, last 3 thoracic, and all abdominal somites dark; last 3 thoracic somites with some dark pigment on lateral processes; last 3 thoracic and first 5 abdominal somites with dorsal rectangular dark patch; pattern on telson faded, but with median triangle, apex at apical spine

of median carina, outlined in dark pigment; uropod with dark color on distal half of proximal segment, inner half of distal segment of exopod, and most of endopod.

Size.—Males, TL 15.5–38.2; females, TL 16.5 (largest specimen broken); juvenile, TL 12.1. Other measurements of male, TL 38.2: carapace length 7.7; cornea width 1.1; stalk width 1.3; eye length 2.2; rostral plate length 1.3, width 1.6; fifth abdominal somite width 10.3; telson length 6.2, width 8.4.

Discussion.—It is with some hesitation that I assign these specimens to Brooks's species, one of the poorest known in the genus. The specimens agree in all respects with his account except that the lateral process of the fifth thoracic somite is inclined slightly forward and there are more spines on the inner margin of the basal prolongation of the uropod. Although Brooks indicated that the ventral surface of the telson of the type was smooth, examination of that specimen revealed a low postanal carina that is present in the Madagascar specimens as well.

Clorida chlorida most closely resembles *C. microphthalma* (H. Milne-Edwards), but the latter has longer, slender eyes, a more elongate rostral plate, a broader carapace, with the lateral margins convex or straight, and a shorter lateral process on the fifth thoracic somite. The differences in shape of the lateral margin of the carapace were noted by R. P. Bigelow in his unpublished work on the Philippine stomatopods; it seems to be a useful character to distinguish these two similar species.

The young specimens are assigned to this species on the basis of their inflated eyes, the same number of teeth on the claw (5), their short rostral plate, and, in the cases of the two larger specimens, a color pattern identical to that of all adults examined.

Kemp (1913) has discounted Lanchester's (1901) record of the species from the Malay Peninsula, which was based on a specimen with submedian carinae on the abdomen.

Distribution.—Indo-West Pacific, from Amboina (Brooks, 1886) and off Madagascar, in depths between 27 and 64 m.

Clorida fallax (Bouvier, 1914)

Figure 2

Squilla fallax Bouvier, 1914, p. 699; 1915, p. 308, figs. 39–42.—Barnard, 1950, p. 841 [footnote and key only].—Serène, 1954, p. 6.—Stephenson and McNeill, 1955, p. 241.

Squilla ambigua Hansen, 1926, p. 6, pl. 1 (figs. 2 a–e).

Previous records.—None.

Material.—1 broken ♀, CL 5.6; Lagon de Mayotte, Comoro Islands; MYT 192 bis; A. Crosnier; August 1959; USNM.

DESCRIPTION.—Eye small, extending beyond end of first segment of antennular peduncle; stalk not markedly dilated, 1.8 times as long as broad; cornea broad, bilobed, broader than stalk and set transversely on it; ocular scales fused and sinuate along midline, acute laterally.

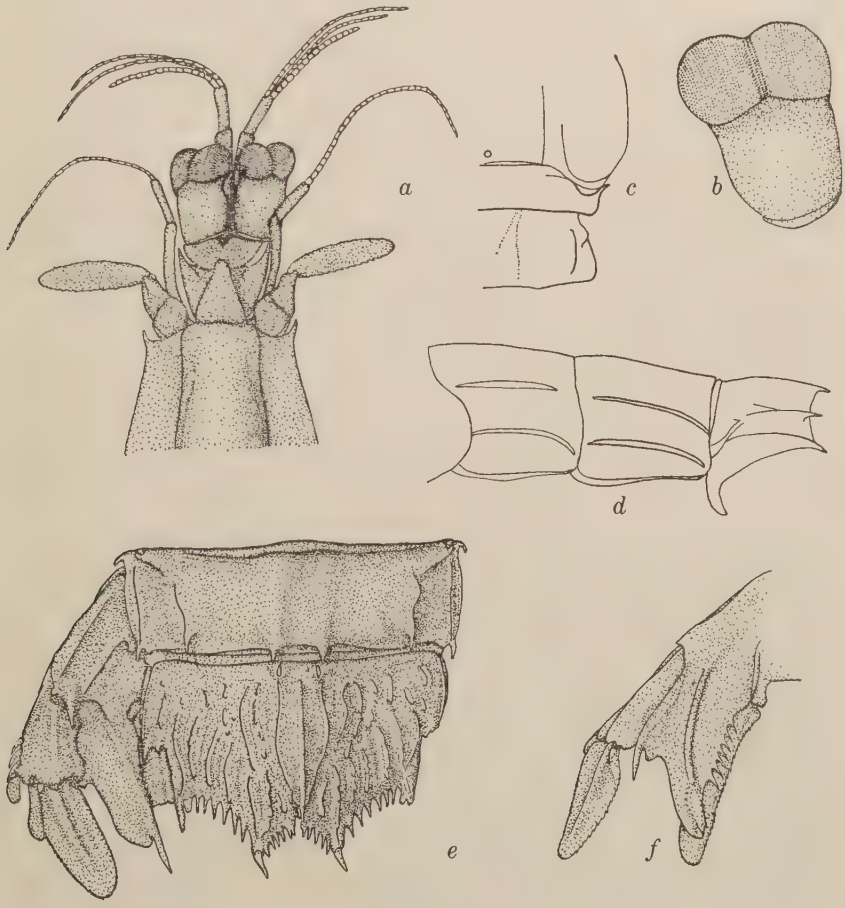

FIGURE 2.—*Clorida fallax* (Bouvier), female, CL 5.6, Comoro Ids.: *a*, anterior portion of body; *b*, eye; *c*, outline of lateral processes of fifth and sixth thoracic somites; *d*, outline of last three abdominal somites, lateral view; *e*, last abdominal somite, telson, and uropod; *f*, uropod, ventral view (outer spine broken). (Setae omitted).

Antennular peduncle short, more than half as long as carapace; dorsal processes of antennular somite visible lateral to rostral plate as slender, anteriorly directed spines.

Antennal peduncle extending to cornea; antennal scale curved, short, less than half as long as carapace.

Rostral plate longer than broad, triangular, apex rounded but acute, median carina absent.

Carapace narrowed anteriorly, completely lacking median and intermediate carinae; reflected marginal carinae present on posterior fourth of carapace; posterior margin straight; anterolateral margins sloping laterally to short anterolateral spines.

Raptorial claw slender; dactylus with 4 teeth, outer margin straight, with 2 proximal lobes, distal larger, separated by a shallow emargination; dorsal ridge of carpus terminating in rounded lobe.

Mandibular palp absent; 4 epipods present.

Exposed thoracic somites lacking submedian carinae; last 3 thoracic somites with low, unarmed intermediate carinae; lateral process of fifth somite a short, slender spine, directed anterolaterally; a pair of long, slender ventral spines also present on fifth somite; lateral processes of next 2 somites subtriangular, not bilobed, rounded or angled, but unarmed posterolaterally; ventral keel of eighth somite a low, obtuse tubercle.

Abdomen broad, depressed, lacking submedian carinae on first 5 somites; only carinae of sixth somite armed with posterior spines; area between submedian and intermediate carinae on sixth somite irregular; sixth somite with ventrolateral spine on each side in front of articulation of uropod.

Telson broader than long, with 3 pairs of sharp marginal teeth, submedians with movable apices; prelateral lobes absent; marginal carinae and carinae of intermediate and lateral teeth smooth, carinae of submedian teeth denticulate dorsally; entire dorsal surface of telson covered with carinae of varying length; dorsal submedian carinae interrupted posteriorly, posterior portions fusing with posterior end of median carina; dorsal surface with 1 short carina present inside carina of submedian tooth and 4 long curved carinae, terminating in tubercles, present between submedian and intermediate teeth; anterior surface of telson with several other carinae of varying length, as shown in figure 2; median carina with distal spine overhanging smaller median spinule; denticles 5–6, 7, 1, most sharp, outer intermediate and lateral denticles rounded; ventral surface with postanal keel flanked laterally by 1 short and 1 long carina and about 14 shorter, longitudinal carinae.

Outer margin of proximal segment of uropodal exopod with 5 movable spines, proximal 3 sharp, distal 2 spatulate, last extending about to midlength of distal segment; proximal segment of exopod with dorsal carina; endopod slender, curved; ventral surface of protopod with carina extending anteriorly from articulation of endopod; inner margin of basal prolongation with 5 slender spines; inner spine of basal prolongation longer; 2 rounded lobes present

between spines of basal prolongation, inner larger, apex deflected dorsally.

Color.—Posterolateral angles of carapace and lateral portions of body black; telson with lateral black patches; uropodal exopod with dark spot at articulation of distal segment.

Size.—Only specimen examined, a female, broken. Measurements: carapace length 5.6; cornea width 1.3; eye length 1.8; stalk width 1.0; rostral plate length 1.2, width 0.8; fifth abdominal somite width 6.5; telson length 3.8, width 5.4.

Discussion.—The present broken specimen agrees very well with the limited accounts of *S. fallax* given by Bouvier (1914, 1915) and the detailed account of *S. ambigua* given by Hansen (1926). Their accounts differ only in the extent of carination of the telson and the armature of the marginal carinae of the abdomen. Bouvier's figure (1915) indicates that most of the dorsal carinae of the telson are broken, whereas the carinae on the telson of Hansen's specimen are mostly entire. In the broken specimen from the Comoro Islands they are divided proximally, entire distally. On another specimen in the U.S. National Museum, from the Solomon Islands, the carinae of the telson are broken mostly into tubercles. In view of the normal variation in telson ornamentation in this genus, the extremes exhibited by Hansen's specimen and Bouvier's as well must be considered within the expected range of variation.

Although the specimen from the Comoro Islands lacks marginal spines on the fifth abdominal somite, as in *S. fallax*, the larger specimen from the Solomon Islands has this spine, which was also present in Hansen's type.

Finally, the dark lateral portions of the body, mentioned by both Hansen and Bouvier, are present in the specimens from both the Indian Ocean and Pacific Ocean.

Distribution.—Indo-West Pacific, from Mauritius (Bouvier, 1914, 1915), Madagascar, Dangar Besaar, Indo-Malaya (Hansen, 1926), Viet Nam (Serène 1954), New South Wales, Australia (Stephenson and McNeill, 1955), and the Solomon Islands.

Clorida miersi, new species

Figure 3

Holotype.—1 ♂, 32.8; Banc de Pracel, western coast of Madagascar; 65 m; sand; A. Crosnier; June 1959; USNM 124091.

Description.—Eye small, extending to end of first segment of antennular peduncle; stalk slightly inflated, not as broad as cornea; cornea small, bilobed, breadth about two-thirds length of eye; ocular scales rounded, fused along midline.

Antennular peduncle elongate, over half as long as carapace; dorsal processes of antennular somite visible lateral to rostral plate as slender, sharp, anteriorly directed spines.

Antennal peduncle not extending beyond eye; antennal scale slender, curved, less than half as long as carapace.

Rostral plate longer than broad, margins proximally subparallel, distally convergent on rounded apex; median carina absent.

Carapace strongly narrowed anteriorly, completely lacking median and intermediate carinae; posterior fourth of carapace with reflected marginal carinae only; posterior margin straight; anterior margins slope posterolaterally to strong anterolateral spines, which do not extend to base of rostral plate.

Raptorial claw slender: dactylus with 5 teeth, outer margin flattened, with proximal notch flanked distally by rounded lobe; dorsal ridge of carpus terminating in low, rounded tubercle.

Mandibular palp and 4 epipods present.

Exposed thoracic somites lacking submedian carinae, least 3 somites with well-formed, unarmed intermediate carinae; lateral process of fifth somite a short, sharp, slender, anterolaterally directed spine; fifth somite with ventral tubercle under each lateral spine; lateral processes of sixth and seventh somites not bilobed, obliquely truncate, rounded anterolaterally and posterolaterally; ventral keel of eighth somite prominent, rounded, projecting ventrally.

Abdomen broad, depressed, first 5 somites lacking submedian carinae; abdominal carinae spined as follows: submedian, 6; intermediate, 5–6; lateral, 6; marginal, 5; sixth somite with ventrolateral spine in front of articulation of each uropod.

Telson broader than long, with 3 pairs of sharp marginal teeth, submedians with movable apices; prelateral lobes absent; carinae of submedian and intermediate teeth nodulose, marginal carinae smooth; telson ornamented dorsally with a series of anterior tubercles, a submedian line of tubercles on each side of median carina converging under its apex, and 6–7 short, curved lines of tubercles; median carina with slender spine and ventral tubercle under spine; denticles sharp, 2–3, 7–8, 1; ventral surface of telson with postanal keel.

Outer margin of proximal segment of uropodal exopod with 6 slender, curved spines, last extending about to midlength of distal segment; proximal segment of exopod with longitudinal dorsal carina; endopod slender, curved; basal prolongation with 7 slender spines on inner margin and broad rounded lobe on outer margin of longer inner spine.

Color.—Almost completely faded; some dark chromatophores present on anterior appendages, arranged in lines on propodus of claw;

uropod with traces of dark pigment on inner half of exopod and distal half of endopod.

SIZE.—Male holotype, only specimen examined, TL 32.8. Other measurements: carapace length 5.2; cornea width 1.3; eye length 1.8;

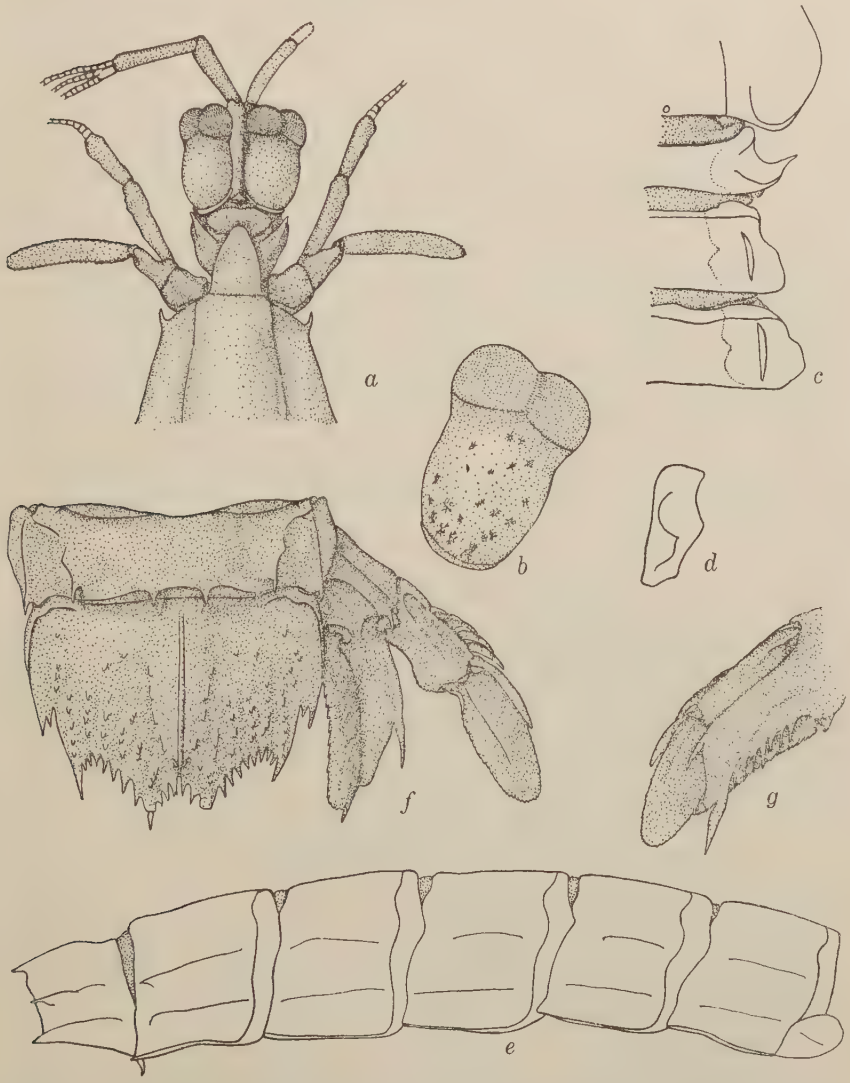

FIGURE 3.—*Clorida miersi*, new species, male holotype, TL 32.8, Banc de Pracel: *a*, anterior portion of body; *b*, eye; *c*, outline of lateral processes of fifth, sixth, and seventh thoracic somites; *d*, outline of fifth thoracic somite, lateral view; *e*, outline of abdomen, lateral view; *f*, last abdominal somite, telson, and uropod; *g*, basal prolongation of uropod, ventral view. (Setae omitted).

stalk width 1.1; rostral plate length 1.4, width 0.9; fifth abdominal somite width 7.3; telson length 3.9, width 5.3.

Discussion.—*Clorida miersi* closely resembles *C. verrucosa* (Hansen) in most features but shows several important differences, as follows: (a) the eyes are of different shape, the stalk is not as long and is less expanded laterally, and the broader cornea is set transversely on the stalk; (b) there are no submedian carinae on the first five abdominal somites, but they are present on the fourth and fifth somites in *C. verrucosa*; (c) fewer abdominal carinae are armed (in *C. verrucosa* the abdominal carinae of the fourth, fifth, and sixth somites are all provided with spines); and (d) the anterior lobe of the lateral process of the fifth thoracic somite is spiniform in *C. verrucosa*, rounded in *C. miersi*.

The large eyes and elongate rostral plate will immediately distinguish this species from the others known from the western Indian Ocean, *C. clorida* (Brooks), *C. fallax* (Bouvier), *C. latreillei* Eydoux and Souleyet, and *C. microphthalma* (H. Milne-Edwards).

Etymology.—The species is named for E. J. Miers, the British carcinologist who made valuable early contributions to our knowledge of the stomatopods.

Distribution.—Known only from the type-locality, off the west coast of Madagascar.

Harpiosquilla Holthuis, 1964

Four species, all from the Indo-West Pacific region, have been assigned to this genus; all four occur in the western Indian Ocean. Balss (1910) reported *H. raphidea* from off East Africa and Chopra (1939) recorded *H. annandalei* from the Gulf of Oman. Two species, *H. harpax* and one described as new, are reported herein. The following key will serve to distinguish all of the species.

Key to Species of *Harpiosquilla*

1. Fifth thoracic somite with a lateral spine 2
   Fifth thoracic somite rounded laterally 3
2. Submedian carinae of fifth abdominal somite armed posteriorly; distal segment of uropodal exopod black with a white midrib . **H. annandalei** (Kemp, 1911)
   Submedian carinae of fifth abdominal somite unarmed; distal segment of uropodal exopod with inner half only dark, not black. **H. raphidea** (Fabricius, 1798)
3. Carapace with median carina; first 5 abdominal somites with submedian carinae . . . . . **H. harpax** (de Haan, 1844)
   Carapace lacking median carina; first 5 abdominal somites lacking submedian carinae . . . . . **H. melanoura,** new species

Harpiosquilla harpax (de Haan, 1834)

FIGURE 4

Squilla harpax de Haan, 1844, pl. 51 (fig. 1).—Tiwari and Biswas, 1952, p. 358, figs. 3b, d, f.—Barnard, 1955, p. 49.—Ingle, 1963, p. 18, figs. 9, 59.—Holthuis, 1964, p. 140 [description of *Harpiosquilla*].
Squilla raphidea.—Crosnier, 1965, p. 61 [listed].
Not *Harpiosquilla harpax*.—Manning, 1966, p. 87, fig. 1 [an undescribed species].
Harpiosquilla harpax.—Manning, 1967, p. 103.

PREVIOUS RECORDS.—Crosnier, 1965.

MATERIAL.—1 ♀, 118.2; Ambaro Bay, Nosy Bé; trawl; 2–5 m; M. Pichon; 8 September 1964; USNM. 1 ♂, 171.0; Baie de Narendry, northwestern coast of Madagascar; trawl; 6 m; mud; A. Crosnier; February 1958; USNM. 1 ♀, 141.5; same; MNHNP.

DESCRIPTION.—Eye large, T-shaped, cornea bilobed, set almost transversely on stalk; eyes not extending past end of first segment of antennular peduncle; ocular scales truncate, situated laterally; anterior margin of ophthalmic somite rounded; corneal indices 269–358.

Antennular peduncle slender, as long as or slightly shorter than carapace; dorsal processes of antennular somite slender, tapered, directed anterolaterally.

Rostral plate triangular, longer than broad, without carinae; lateral margins sinuous, convex posteriorly, convex anteriorly, converging on short, blunt apex that extends just beyond edge of antennular somite.

Carapace narrowed anteriorly, anterior width less than one-half median length; anterolateral spines strong but not extending to base of rostral plate; median carina present, not bifurcate at either end; intermediate carinae not extending to anterior margin.

Mandibular palp and 5 epipods present.

Raptorial claw large, propodus almost half again as long as carapace; dactylus with outer margin evenly curved in female, with proximal obtuse angle in male, inner margin with 8 teeth; propodus with erect spines and tubercles on margin opposing dactylus; dorsal ridge of carpus undivided.

Exposed thoracic somites with, at most, vestiges of submedian carinae, last three somites with prominent unarmed intermediate carinae; lateral process of fifth somite rounded, obscure, a ventral spine, with convex posterior lobe, present on each side; lateral process of sixth somite bilobed, anterior lobe low, rounded, posterior triangular, with spiniform apex; lateral process of seventh somite with irregular margin, at most an anterior tubercle present, posterolaterally spiniform; ventral keel on eighth somite rounded, inclined posteriorly.

Abdomen with submedian carinae of first 5 somites low, poorly developed, but present; remainder of abdominal carinae well-formed, spined as follows: submedian, 6; intermediate, 2–6; lateral, 1–6; marginal, 1–5; sixth somite with sharp spine in front of articulation of each uropod and with median ventral carina.

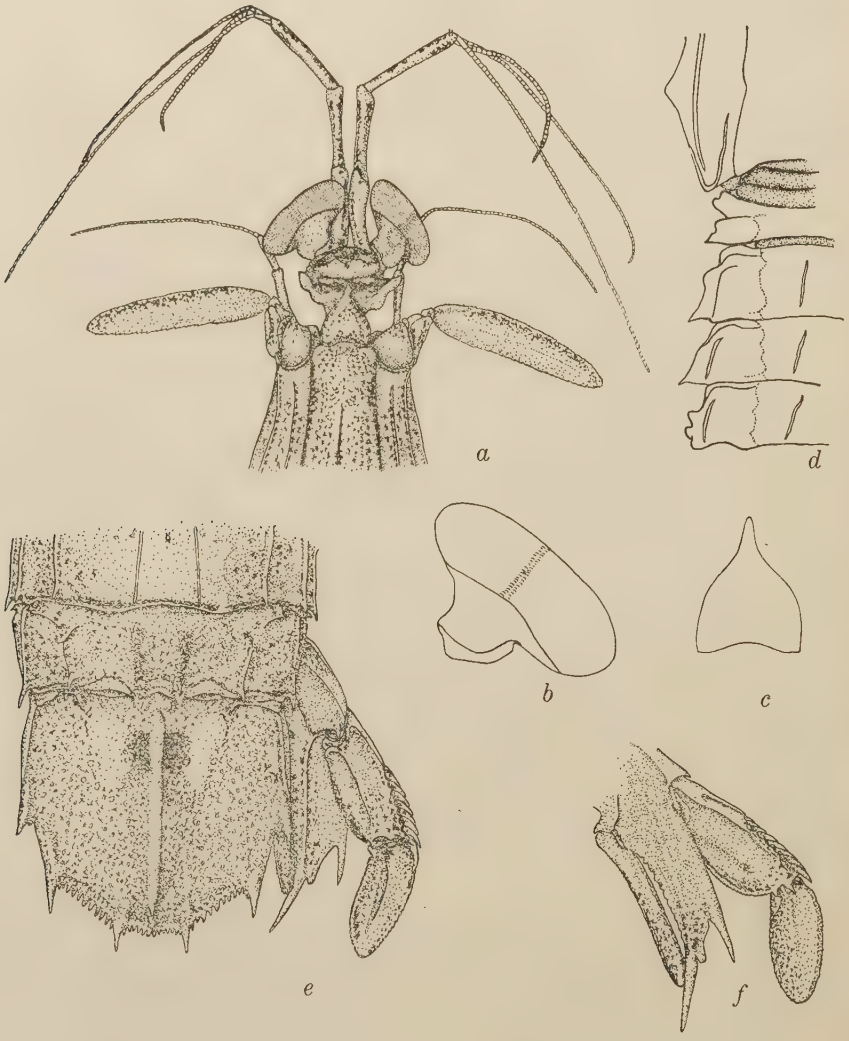

FIGURE 4.—*Harpiosquilla harpax* (de Haan), female, TL 118.2, Ambaro Bay: *a*, anterior portion of body; *b*, outline of eye; *c*, outline of rostral plate; *d*, outline of lateral processes of exposed thoracic somites; *e*, last two abdominal somites, telson, and uropod; *f*, basal prolongation of uropod, ventral view. (Setae omitted).

Telson as broad as long, appearing elongate; carinae of marginal teeth short, rounded, slightly nodulose dorsally; 3 pairs of marginal teeth present, prelateral lobe formed dorsally but not projecting laterally; marginal carina over twice as long as carina of lateral tooth; denticles subequal, sharp, 4–7, 10–12, 1; ventral surface with postanal keel extending about halfway between anus and posterior margin.

Uropod with 9 movable teeth on outer margin of proximal segment of exopod, last short; lobe on outer margin of inner spine of basal prolongation prominent, rounded, margin concave.

Color.—Anterior edge of antennal scale dark; carinae, grooves, and posterior margin of carapace dark; thoracic and abdominal somites with anterior and posterior dark, transverse lines, posterior broader and darker, and intermediate and marginal carinae outlined with dark pigment; telson with pair of anterior, submedian, round black spots; carinae and margins of uropod with dark chromatophores, particularly inner margin of exopod; endopod with dark pigment lining both edges of distal half, central portion clear.

Size.—Male, TL 171.0; females, TL 118.2–141.5. Other measurements of male, TL 171.0: carapace length 32.2; cornea width 10.4; rostral plate length 5.6, width 5.1; fifth abdominal somite width 32.8; telson length 30.4, width 30.4.

Discussion.—The presence of a median carina on the carapace, submedian carinae on the abdomen, and the lighter colored uropods distinguish this species from *H. melanoura*, new species, described below. Other differences are discussed under the account of the new species.

Harpiosquilla harpax lacks the lateral spine on the fifth thoracic somite, which is characteristic of *H. raphidea* (Fabricius), and lacks the armed intermediate carinae of the thoracic somites, which characterize *H. annandalei* (Kemp) and which may occur also in very large specimens of *H. raphidea*. In their account separating *H. harpax* from *H. raphidea*, Tiwari and Biswas (1952) also pointed out other differences between the two species.

The specimen from Australia assigned to this species by Manning (1966) belongs to an undescribed species, an account of which is in preparation.

Through the kindness of L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, Leiden, I was able to study one of the syntypes of *Squilla harpax* de Haan and compare it directly with the specimens of *H. harpax* and *H. melanoura*, new species, reported here. The specimen, a male, TL 152.5, from Japan, RMNH 28H, is here selected as the lectotype of *Squilla harpax*. It agrees in all details with the specimens of *H. harpax* from Madagascar.

273–102—67——2

The corneal indices of the two females of *H. harpax* reported here, CL 21.0 and 28.5, are 269 and 320; in the two males (including the lectotype), CL 29.1–32.2, they are 316 and 358, respectively. Tiwari and Biswas (1952) reported a range of 2.7–3.2 (270–320) in their material. Not enough material is available to determine if there are any sexual or geographic differences in the corneal indices of this species.

The eyes of *H. melanoura*, new species, appear to be larger, and the range of corneal indices, 229–252, indicates that the cornea is appreciably broader in that species.

The corneal index of the specimen reported from Australia by Manning (1966), a female, CL 30.6, was 336, which falls within the range observed for *H. harpax*. In the Australian specimen, however, the eye appears to be more inflated than in *H. harpax*.

Distribution.—Indo-West Pacific, from the Red Sea and East Africa to Japan.

Harpiosquilla melanoura, new species

Figure 5

Holotype.—1 ♂, 128.6; Banc de Pracel, western coast of Madagascar; 55 m; sand; A. Crosnier; July 1959; USNM 124092.

Paratypes.—1 ♀, 135.6; Banc de Pracel, western coast of Madagascar; 55 m; muddy sand; A. Crosnier; June 1959; USNM 124093. 1 ♂, 101.6; 1 ♀, 126.1; same; MNHNP.

Description.—Eye large, T-shaped, cornea bilobed, set almost transversely on stalk; eyes extending anteriorly almost to end of first segment of antennular peduncle; ocular scales obliquely truncate or rounded, situated laterally; anterior margin of ophthalmic somite rounded; corneal indices 229–252.

Antennular peduncle slender, slightly longer than carapace; dorsal processes of antennular somite broad, each tapered to an acute apex, directed anterolaterally.

Antennal scale slender, curved, two-thirds as long as carapace.

Rostral plate triangular, longer than broad, without carinae; lateral margins sinuous, convex posteriorly, concave anteriorly, converging on slender, blunt apex; plate extending just beyond dorsal margin of antennular somite.

Carapace narrowed anteriorly, anterior width less than one-half median length; anterolateral spines strong but not extending to base of rostral plate; median carina completely absent; intermediate carinae not extending to anterior margin.

Mandibular palp and 5 epipods present.

Raptorial claw large, propodus slightly less than half again as long as carapace; dactylus with 8 teeth, outer margin of dactylus evenly

curved in female, with proximal, obtuse, angular prominence in male; propodus with series of upright spines on upper margin; dorsal ridge of carpus undivided.

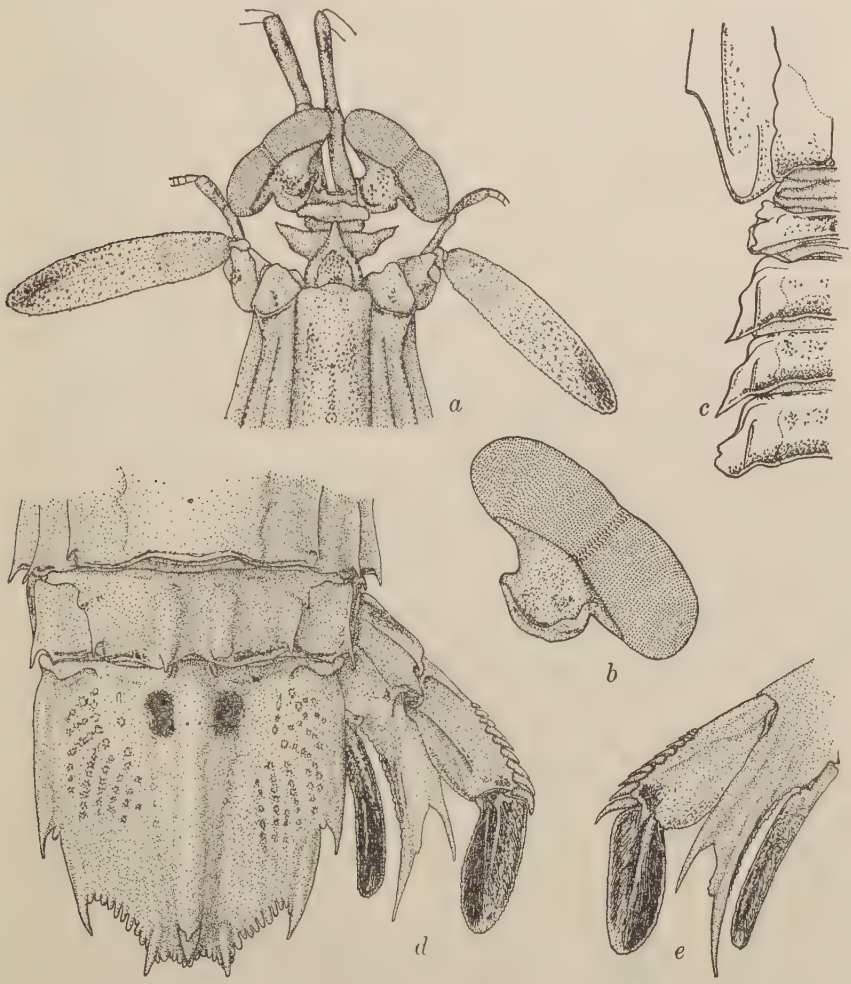

FIGURE 5.—*Harpiosquilla melanoura*, new species, male holotype, TL 128.6, Banc de Pracel: *a*, anterior portion of body; *b*, eye; *c*, lateral processes of exposed thoracic somites; *d*, last two abdominal somites, telson, and uropod; *e*, basal prolongation of uropod, ventral view. (Setae omitted).

Exposed thoracic somites lacking submedian carinae, last 3 somites with short, unarmed intermediate carinae; lateral process of fifth thoracic somite obscure, unarmed; fifth somite with slender ventral spine on each side, margins sinuous, apex very sharp; lateral process

of sixth somite bilobed, anterior lobe obtusely rounded, posterior triangular, apex spiniform; lateral process of seventh somite not conspicuously bilobed, margin sinuous, triangular posterolateral apex spiniform; ventral keel of eighth somite inclined posteriorly, rounded anteriorly, angled or rounded posteriorly.

Abdomen lacking submedian carinae on first 5 somites; remainder of abdominal carinae well-formed, spined as follows: submedian, 6; intermediate, 2–6; lateral, 1–6; marginal, 1–5; sixth somite with sharp posterolateral spine in front of articulation of uropod and short, median, ventral keel.

Telson noticeably longer than broad, median carina thick, terminating in slender posterior spine; carinae of marginal teeth short, rounded, slightly irregular dorsally; 3 pairs of marginal teeth present, prelateral lobes formed dorsally but not projecting laterally; marginal carina almost 3 times as long as carina of lateral tooth; denticles subequal, angular but not sharp, 5, 9–10, 1; ventral surface with short postanal keel, not extending halfway from anus to posterior margin.

Uropod with 9 graded, movable spines on outer margin of proximal segment of exopod, last short; lobe on outer margin of inner spine of basal prolongation prominent, rounded, inner margin concave.

Color.—Anterolateral angle of antennal scale black; carapace with U-shaped median dark patch, open anteriorly, anteror to cervical groove; posterior margin of carapace, last 3 thoracic somites, and first 5 abdominal somites black; telson with pair of proximal, submedian black squares, convergent rows of pits on surface black; distal segment of uropodal exopod black, with small, clear posterolateral area; distal two-thirds of uropodal endopod black.

Size.—Males, TL 101.6–128.6; females, TL 126.1–135.6. Other measurements of male holotype: carapace length 24.4; cornea width 10.2; rostral plate length 4.6, width 4.1; fifth abdominal somite width 24.6; telson length 24.5, width 21.7.

Discussion.—*H. melanoura* most closely resembles *H. harpax* (de Haan), but it differs in several important features, as follows: (a) the eyes are noticeably larger; (b) the median carina of the carapace is absent; (c) submedian carinae are absent on the first five abdominal somites; (d) the telson is slenderer and longer; (e) the postanal keel is shorter, less than half the distance between the anus and the posterior margin of the telson; and (f) the distal portions of the uropod are black. Specimens of the two species can be separated immediately by the differences in color of the uropod alone.

Harpiosquilla raphidea (Fabricius) is a larger species, in which the lateral process of the fifth thoracic somite is spined; it is unarmed in *H. melanoura*. The only other known species of *Harpiosquilla*, *H.*

annandalei (Kemp), differs from *H. melanoura* in having the intermediate carinae of the last three thoracic somites armed with a posterior spine.

The four specimens of *H. melanoura* described here have been compared with the lectotype of *H. harpax* (de Haan).

Etymology.—The name is derived from the Greek, "melanos," meaning "dark," and from "oura," meaning "tail," referring to the dark uropods of the species.

Distribution.—Known only from the type-locality, Banc de Pracel, off the west coast of Madagascar; all specimens were taken at 55 m.

Squilla Fabricius, 1787

Ten species of *Squilla* have been recorded in the western Indian Ocean from localities between the Red Sea and southern Moçambique, and five of these occur off Madagascar. The five species not now recorded from Madagascar are: *Squilla investigatoris* Lloyd, 1907, from the Gulf of Aden (Chopra, 1939; Ingle, 1963); *S. mikado* Kemp and Chopra, 1921, from Zanzibar and Moçambique (Chopra, 1939; Barnard, 1950; Manning, 1965); *S. massavensis* Kossmann, 1880, from the Red Sea and Zanzibar(?) (Ingle, 1963); *S. minor* Jurich, 1904, from Zanzibar; and *S. woodmasoni* Kemp, 1911, from Zanzibar(?) and Moçambique (Kemp, 1913; Barnard, 1962). With the exception of *S. massavensis*, which may not occur south of the Red Sea (see discussion below), any of these species could occur off Madagascar.

Squilla carinata Serène, 1950

Figure 6

Squilla multicarinata.—Dollfus, 1938, p. 196, fig. 1.—Gravier, 1938, p. 174, fig. 4 [not *S. multicarinata* White].

Squilla carinata Serène, 1950, p. 571; 1954, pp. 6, 8.—Ingle, 1963, p. 17, figs. 6–8, 10–12, 67.

Previous records.—None.

Material.—1 ♀, 65.1; Banc de Pracel, western coast of Madagascar; 55 m; muddy sand; A. Crosnier; June 1959; MNHNP. 1 ♂, 88.4; Baie d'Ambaro, Madagascar; 26 m; shelly sand; A. Crosnier; June 1959; USNM.

Description.—Body covered with short, longitudinal carinae; antennular peduncle longer than carapace and rostral plate combined; eye of moderate size, cornea set obliquely on stalk, stalk with several irregularly placed dorsal carinae; ocular scales bifurcate, apices rounded or acute; rostral plate appearing elongate, with long median carina and carinate lateral margins; carapace narrowed anteriorly, covered with longitudinal carinae, median carina with anterior

bifurcation, posterior margin produced into median point; antero-lateral spines of carapace strong but not extending to base of rostral plate; mandibular palp and 4 epipods present; raptorial claw slender, dactylus with 6 teeth, outer margin of dactylus flattened but not conspicuously sinuate; dorsal ridge of carpus undivided; fifth thoracic somite irregularly carinate, with longitudinal and transverse carinae; anterior portion of lateral process of fifth somite directed antero-laterally, apex blunt; posterior lobe slender, apex rounded; submedian carinae of last 3 thoracic somites armed posteriorly, at least 4 of carinae between submedians also armed; lateral process of sixth somite bilobed, anterior lobe large, apex obliquely truncate, posterior lobe triangular,

FIGURE 6.—*Squilla carinata* Serène, male TL 88.4, Ambaro Bay: anterior portion of body.

slenderer; lateral process of seventh thoracic somite bilobed, both lobes triangular, anterior lobe smaller; ventral keel on eighth thoracic somite low, triangular; each abdominal somite with numerous longitudinal carinae, last somite with fewest; abdomen with submedian, intermediate, and lateral carinae spined posteriorly on all 6 somites, marginals of first 5 somites also armed; on first 5 somites median and up to 4 other carinae between submedians also armed; on fifth somite only, 1–2 carinae on each side between intermediate and lateral carinae spined; remainer of abdominal carinae unarmed; telson slender, longer than broad, with 4 pairs of sharp marginal teeth and 12 or more carinae of varying length on either side of median carina;

denticles rounded, 4–5, 8–9, 1; ventral surface of telson with postanal keel flanked by numerous longitudinal carinae; uropod slender, elongate, all segments longitudinally carinate; penultimate segment of exopod with 11 graded, movable spines, last not extending to mid-length of distal segment; basal prolongation of uropod with series of short spines on inner margin, lobe on outer margin of inner spine small, acute.

Color.—Posterior margin of carapace, last 3 thoracic and first 5 abdominal somites lined with black; body carinae with faint traces of longitudinal lines of dark pigment; telson with bases of intermediate, lateral, and marginal teeth dark, dark pigment on telson terminating anteriorly at a line across level of posterior spine of median carina; uropodal exopod with distal fourth of proximal segment and most of distal segment black, apex clear; distal third of uropodal endopod black.

Size.—Male, TL 88.4; female, TL 65.1. Other measurements of male: carapace length 19.8; cornea width 4.4; rostral plate length 3.0, width 2.6; telson length 17.2, width 14.8.

Discussion.—The description given above is based on the two specimens reported herein. Judging from other accounts in the literature, this species exhibits some variation in ornamentation and sination of the body carinae. Dollfus (1938, fig. 7) showed that in one specimen from the Gulf of Suez several of the body carinae, other than those reported here, terminated in spines.

The present material agrees with Serène's account in having carinae on the eyestalks, bifurcate ocular scales, and a mandibular palp. Serène did not go into any detail on the other features of his material but did mention that the first two of these characters would differentiate this species from others. The Madagascar specimens agree well with the accounts of the species given by Gravier (1938), Dollfus (1938), and Ingle (1963).

Distribution.—Indo-West Pacific, from the Gulf of Suez, Madagascar, and Viet Nam; the species has not been recorded previously from Madagascar.

Squilla gonypetes Kemp, 1911

Figure 7

Squilla gonypetes.—Kemp, 1913, p. 54, pl. 4 (figs. 42–44).—Ingle, 1963, p. 15, figs. 1, 5, 14.—Manning, 1965, p. 250, pl. xi (fig. b) [older references].

Previous records.—None.

Material.—1 ♂, 53.1; 1 ♀, 45.2; Banc de Pracel, western coast of Madagascar; 55 m; muddy sand; A. Crosnier; June 1959; USNM. 1 ♂, 51.4; 1 ♀, 38.8; same; MNHNP. 1 ♂ postlarva, 14.8; Large Baie

Moramba, northwestern coast of Madagascar; dredge; 30 m; muddy sand; A. Crosnier; 1 March 1958; USNM.

Diagnosis.—Eye small, cornea set obliquely on stalk; rostral plate without median carina; anterior bifurcation of median carina of carapace obscure, interrupted in some specimens; dactylus of raptorial claw with 5 teeth; dorsal ridge of carpus of claw undivided; inferodistal

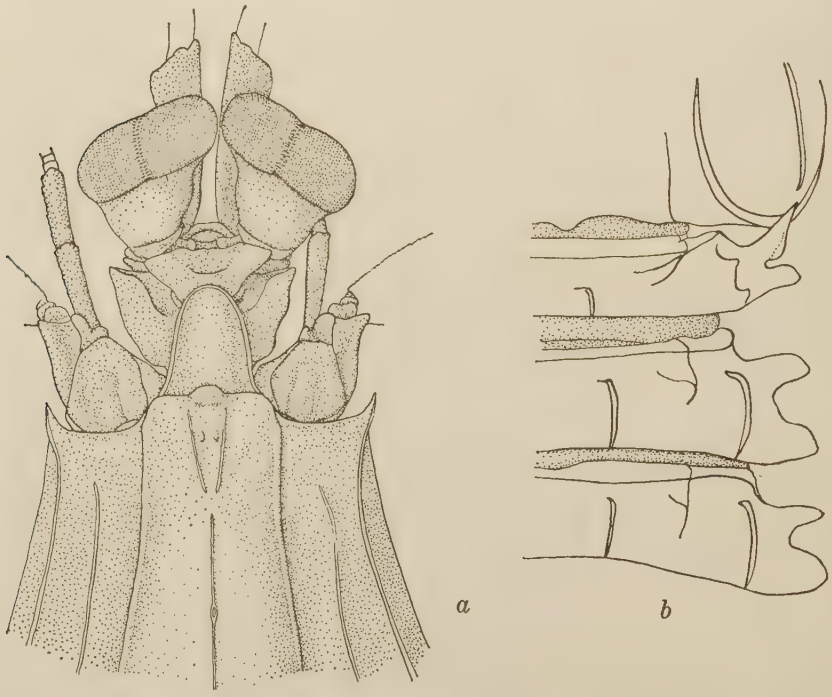

Figure 7.—*Squilla gonypetes* Kemp, male, TL 53.1, Banc de Pracel: *a*, anterior portion of body; *b*, outline of lateral processes of fifth, sixth and seventh thoracic somites.

angle of merus of claw unarmed; mandibular palp and 4 epipods present; lateral processes of fifth to seventh thoracic somites bilobed, anterior lobe of process of seventh somite well developed; abdominal carinae spined as follows: submedian, 5–6; intermediate, 4–6; lateral, 3–6; marginal, 1–5; telson with 4, 7, 1 denticles, outer submedian and outer intermediate larger than remainder; ventral surface of telson with short postanal keel.

Color.—Thoracic and abdominal somites with dark, irregular posterior line; second abdominal somite with dark transverse patch, fifth somite with pair of dark, triangular submedian patches; sixth abdominal somite black posterolaterally; telson with rectangular anterior and triangular posterior dark patches along median carina;

uropodal exopod with distal portion of proximal segment and inner half of distal segment with scattered dark chromatophores; distal half of endopod dark.

Discussion.—These specimens agree in most details with Kemp's (1913) account of the species, but differ in the following features: (a) the rostral plate appears to be more elongate; (b) the branches of the anterior bifurcation of the median carina of the carapace are present although obscure; (c) the dactylus of the claw is curved more strongly; (d) the posterior lobe of the lateral process of the seventh thoracic somite is not acute but rounded; (e) the intermediate carinae of the third abdominal somite and the lateral carinae of the second somite are unarmed; and (f) the submedian dark squares of the fifth abdominal somite are represented in these specimens by triangles. Kemp noted that one specimen from Madras differed in these respects from other material available to him. This species still is known too poorly to determine whether or not these differences reflect normal variation, or whether or not two or more species are present.

Distribution.—Indo-West Pacific, from scattered localities between the Red Sea and Japan.

Squilla hesperia, new species

Figure 8

?*Squilla nepa*.—Miers, 1880, p. 25 [part; specimen from Zanzibar].

?*Squilla woodmasoni*.—Kemp, 1913, p. 74 [part; specimens from Zanzibar reported by Miers (1880), reidentified].

?*Squilla massavensis*.—Ingle, 1963, p. 15 [part; specimens from Zanzibar reported by Miers (1880) and Kemp (1913), reidentified].

Holotype.—1 ♀, 116.6; Baie de Tsimipaika, northwestern coast of Madagascar; trawl; 15 m; muddy sand; A. Crosnier; March 1959; USNM 124094.

Description.—Eye large, cornea bilobed, set very obliquely on stalk; prominent lateral projection present on each stalk; eyes extending to end of first segment of antennular peduncle; anterior margin of ophthalmic somite obtusely rounded; corneal index 364.

Antennular peduncle slightly shorter than carapace; dorsal processes of antennular somite visible lateral to rostral plate as slender, acute projections, directed anterolaterally.

Antennal scale slender, curved, over one-half as long as carapace.

Rostral plate subquadrate, as long as broad, margins sloping to rounded apex; neither median carina nor median tubercle present; lateral margins carinate.

Carapace broad, anterior width more than one-half median length, excluding rostral plate; anterolateral spines of carapace not extending to base of rostral plate; anterior portion of median carina of carapace

lacking bifurcation, posterior portion bifurcate anteriorly; posterior margin of carapace with angular median prominence; intermediate carinae of carapace not extending to anterior margin; posterolateral margins not angled anteriorly.

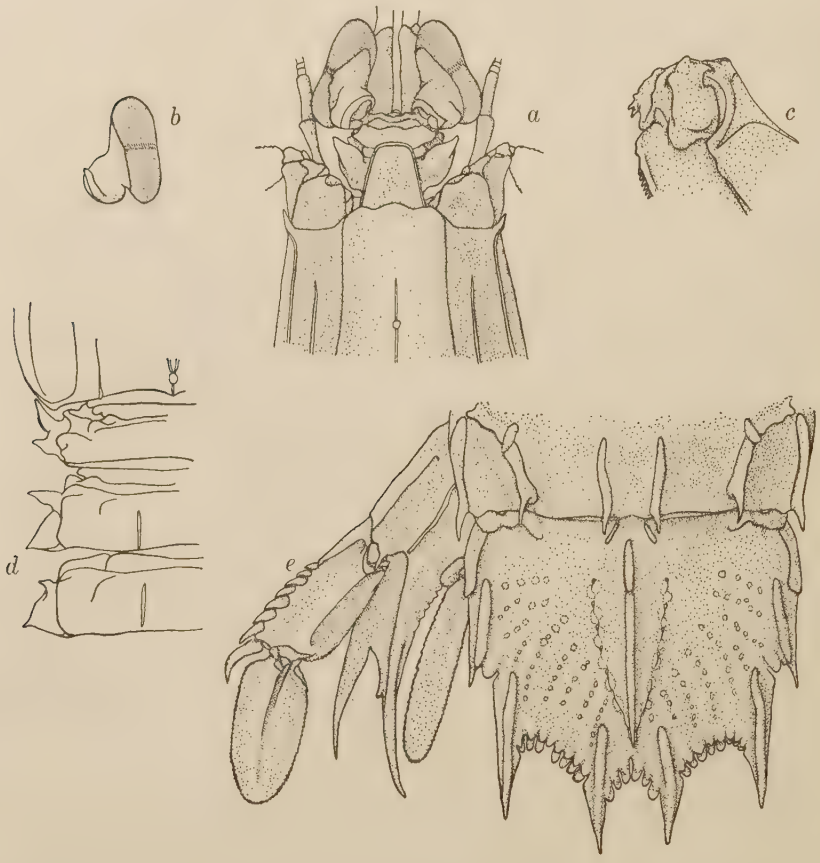

FIGURE 8.—*Squilla hesperia*, new species, female holotype, TL 116.6, Baie de Tsimipaika: *a*, anterior portion of body; *b*, eye; *c*, outline of carpus of raptorial claw; *d*, outline of lateral processes of fifth, sixth, and seventh thoracic somites; *e*, last abdominal somite, telson, and uropod (setae omitted).

Dactylus of raptorial claw with 6 teeth, outer margin of dactylus sinuate; dorsal ridge of carpus with 3 tubercles; inferodistal angle of merus at most angled, not strongly spined.

Mandibular palp and 4 epipods present.

Last 3 thoracic somites with submedian and intermediate carinae, none armed; lateral process of fifth somite bilobed, anterior lobe produced into a blunt, anteriorly directed spine, posterior lobe short,

slender, triangular, directed laterally; lateral process of sixth somite bilobed, both lobes triangular, anterior lobe shorter and much slenderer than posterior; lateral process of seventh somite bilobed, anterior lobe obtuse, smaller than that of sixth somite, posterior lobe as long as but broader than posterior lobe of sixth somite; ventral keel of eighth somite low, rounded.

Abdomen with 8 carinae on first 5 somites, 6 on last, submedians subparallel on each somite; second to fifth somites with anterior pair of tubercles lateral to intermediate carinae; abdominal carinae spined as follows: submedian, 4–6; intermediate, 3–6; lateral, 1–6; marginal, 1–5; sixth somite with sharp ventral spine on each side in front of articulation of uropod.

Telson slightly longer than broad, with 6 sharp marginal teeth, each with short dorsal carina; prelateral lobe present; anterior portion of median carina flanked by 2 short, oblique carinae at level of submedian carinae of sixth somite; median carina interrupted anteriorly, terminating posteriorly in slender spine overhanging 2 tubercles; convergent line of pits lateral to median carina marked by mesial tubercles at middle of telson, mesial carina distally; remainder of dorsal surface of telson smooth, convergent rows of pits neither in well-marked grooves nor separated by carinae or low ridges; denticles rounded, subequal, 3, 8, 1, each with proximal dorsal swelling; ventral surface of telson with postanal keel.

Proximal segment of uropodal exopod with 7–8 graded, movable spines, last short, not extending to midlength of distal segment; lobe on outer margin of inner spine of basal prolongation rounded, projecting slightly, margin concave.

Color.—Antennal scale outlined in dark pigment; carinae of body dark; last 3 thoracic and first 5 abdominal somites with dark posterior line; telson with dark bar across surface, distal portion of median carina and marginal carinae dark; distal half of proximal segment and inner half of distal segment of uropodal exopod black; distal half of uropodal endopod black.

The color pattern is very similar to that found in *S. massavensis* Kossmann.

Size.—Female holotype, only specimen examined, TL 116.6. Other measurements: carapace length 23.3; cornea width 6.4; rostral plate length 4.0, width 4.0; telson length 21.1, width 20.2.

Discussion.—*Squilla hesperia* closely resembles *S. massavensis* Kossmann, from the Red Sea but differs in having the rostral plate shorter and broader, in having the submedian carinae of the abdomen divergent on each somite rather than subparallel, and in having many less dorsal tubercles on the telson. *Squilla massavensis* has two submedian rows of tubercles converging distally on the median carinae of

the telson and has one or more tubercles lateral to these rows. In addition, adults of *S. massavensis* may have the dorsal surface of the telson ornamented with curved rows of carinae between the curved rows of pits; most of the dorsal surface of the telson in *S. hesperia* is smooth.

In the holotype of *S. hesperia* the anterior lobe of the lateral process of the sixth thoracic somite is slenderer than that found in any of the specimens of *S. massavensis* examined.

Judging from the accounts of Kemp (1913) and Serène (1954), specimens identified as *S. massavensis* from outside of the Red Sea do not belong to that species. I have seen small specimens of a *Squilla* from the Persian Gulf in which the submedian carinae of the fourth abdominal somite are unarmed and which also differ from *S. massavensis* in having dark dorsal patches on the second and fifth abdominal somites. It seems likely that specimens reported in the literature as *S. massavensis* from localities outside of the Red Sea belong to *S. hesperia* or to one or more undescribed species.

The records of Miers (1880), Kemp (1913), and Ingle (1963), all based on the same two specimens from Zanzibar, are included tentatively in the synonomy of *S. hesperia;* these two specimens must be reexamined.

Etymology.—The name is derived from the Latin, "hesperius," meaning "western."

Distribution.—Known only from the type-locality.

Squilla mauritiana Kemp, 1913

Figure 9

Squilla mauritiana Kemp, 1913, p. 68.
Squilla juxtaoratoria Ward, 1942, p. 55.

Previous records.—None.

Material.—1 ♀, 102.0; Ile Europa, off Madagascar; P. Fourmanoir; USNM.

Description.—Eye of moderate size, cornea bilobed, set obliquely on stalk; eyes not extending to end of first segment of antennular peduncle; anterior margin of ophthalmic somite rounded, faintly emarginate along midline; ocular scales obliquely truncate; corneal index 397.

Antennular peduncle shorter than carapace; dorsal processes of antennular somite triangular, apices acute, directed anterolaterally.

Antennal scale slender, curved, about three-fifths as long as carapace.

Rostral plate slightly broader than long, appearing elongate, with upturned lateral margins; apex rounded; median tubercle present on dorsal surface.

Carapace narrowed anteriorly, anterior width less than one-half median length; median carina low, entire, not as sharp as remainder of carinae, with well-marked anterior bifurcation; distance from dorsal pit to bifurcation less than distance from bifurcation to anterior margin; portion of median carina posterior to cervical groove also bifurcate anteriorly; posterior margin projecting along midline;

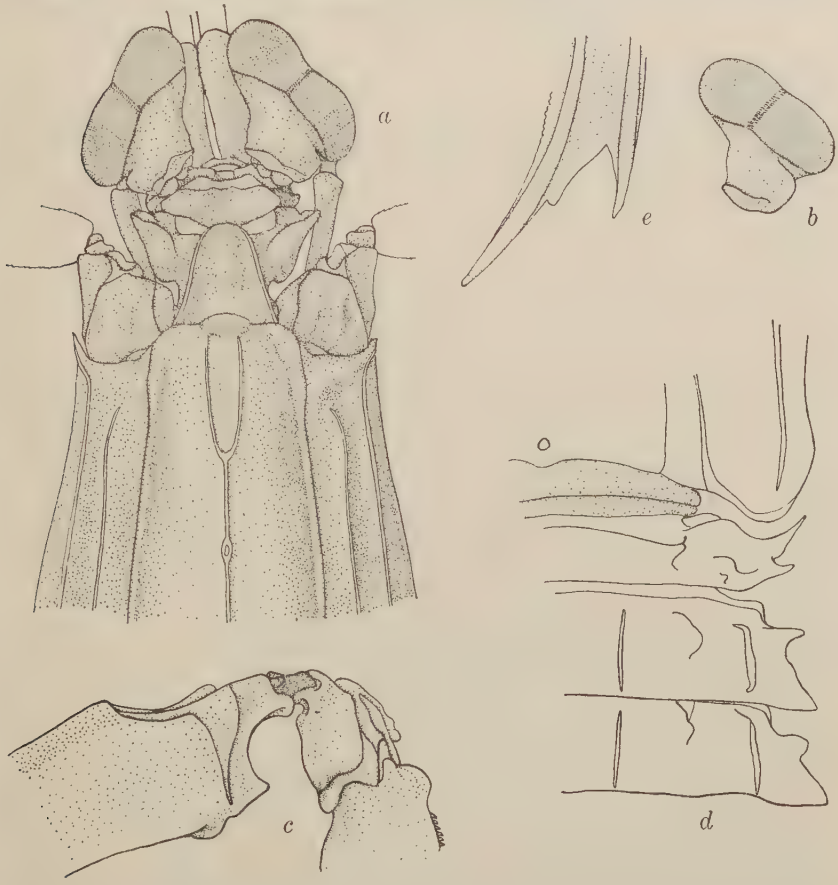

FIGURE 9.—*Squilla mauritiana* Kemp, female, TL 102.0, Ile Europa: *a*, anterior portion of body; *b*, eye; *c*, carpus of raptorial claw; *d*, outline of lateral processes of fifth, sixth, and seventh thoracic somites; *e*, basal prolongation of uropod, ventral view.

anterolateral spines strong but not extending to base of rostral plate; intermediate carinae not extending to anterior margin; posterolateral portion of margin lacking anterior angle.

Dactylus of raptorial claw with 6 teeth, outer margin sinuate; dorsal ridge of carpus with 2 tubercles; inferodistal angle of merus with blunt spine.

Mandibular palp and 4 epipods present.

Last 3 thoracic somites with unarmed submedian and intermediate carinae; lateral process of fifth somite bilobed, anterior lobe a slender, anteriorly curved spine, posterior lobe slender, short, directed laterally; lateral process of sixth somite bilobed, both portions triangular, acute, anterior much slenderer and shorter than posterior; lateral process of seventh somite bilobed, anterior lobe small, obtuse, posterior lobe much larger, triangular; ventral keel of eighth somite rounded, inclined posteriorly.

Abdomen with 8 carinae on first 5 somites, 6 on last, submedians slightly divergent on each somite; abdominal carinae spined as follows: submedian, 4–6; intermediate, 2–6; lateral, 1–6; marginal, 1–5; sixth somite with spine on each side in front of articulation of uropod.

Telson longer than broad, with 6 sharp marginal teeth, each with short dorsal carina; prelateral lobe present; denticles rounded, 4–5, 7–8, 1; ventral surface with postanal keel.

Proximal segment of uropodal exopod with 9 graded, movable spines, last short, not extending to midlength of distal segment; lobe on outer margin of inner spine of basal prolongation prominent, rounded, margin concave.

Color.—Largely faded in specimen from Madagascar except for dark pigment on uropods; proximal segment of exopod with distal half dark, distal segment with dark patch on proximal half of inner side; distal half of endopod dark.

Size.—Only specimen examined, female, TL 102.0; other measurements of female: carapace length 23.0; cornea width 5.8; rostral plate length 3.5, width 3.8; telson length 21.4, width 18.9.

Discussion.—In his account of the variation in *Squilla oratoria*, Kemp (1913, p. 68) noted that two specimens from Mauritius differed from typical *S. oratoria* in having (a) a longer rostral plate, (b) the anterior portion of the lateral process of the sixth thoracic somite shorter than the posterior, and (c) the submedian carinae of the fourth and the lateral carinae of the first and second abdominal somites spined posteriorly. It was in this account that the name, "*S. mauritiana*," a manuscript name of Wood-Mason, was introduced. The specimens reported here differs from *S. oratoria* in these three features.

In 1942 Ward described *Squilla juxtaoratoria* from Mauritius. Although he gave some differences between his species and *S. oratoria*, his account was too brief to permit recognition of the species. Through the kindness of M. Claude Michel of the Mauritius Institute, I was able to examine Ward's type and confirm that it is conspecific with the specimen reported here. A more complete account of the type is in preparation in a review of the species of the "*oratoria* group."

Kemp (1913, p. 68) also noted that his specimens from Mauritius resembled material from Hawaii, which shared the distinctive features mentioned above. The form from Hawaii is another distinct species the description of which is in preparation.

Squilla mauritiana agrees with *S. oratoria* in having the median carina of the carapace uninterrupted; that character will distinguish both species from *S. fabricii* Holthuis, *S. inornata* Tate, *S. interrupta* Kemp, and *S. perpensa* Kemp. *Squilla woodmasoni*, *S. hesperia*, and *S. massavensis*, other species of the "*oratoria* complex" that occur in the western Indian Ocean, lack the anterior bifurcation on the median carina of the carapace; *S. woodmasoni* has a much broader carapace and smoother telson than either *S. hesperia* or *S. massavensis*. Manning (1966) outlined the diagnostic features of several of the species in the "*oratoria* complex."

Distribution.—Indian Ocean, from Mauritius, and Madagascar.

Squilla nepa Latreille, 1825

Figure 10

Squilla nepa.—Lenz, 1910, p. 571.—Kemp, 1913, p. 60, pl. 4 (fig. 49) [older references].—Gravier, 1920, p. 377.—Holthuis, 1941, p. 245.—Barnard, 1950, p. 847, figs. 1b, 2a.—Fourmanoir, 1953, p. 153.—Kurian, 1954, p. 85.—Serène, 1954, pp. 6, 8.—Stephenson and McNeill, 1955, p. 243.—Crosnier, 1965, p. 61 [listed].

Previous records.—Tamatave (Lenz, 1910); Diego Suarez (Gravier, 1920); several localities (Fourmanoir, 1953); no specific locality (Crosnier, 1965).

Material.—2 ♀, 122.6–127.0; Baie Narendry, northwestern coast; trawl; 6–7 m; soft mud; A. Crosnier; February 1958; MNHNP. 2 ♀, 85.8–128.6; same; USNM. 5 ♂, 89.6–132.2; 4 ♀, 100.7–135.8; Ambaro Bay, Nosy Bé; trawl; 2–5 m; M. Pichon; 8 September 1964; USNM. 12 ♂, 89.2–126.7; 24 ♀, 70.0–146.0 (in 5 lots); from localities around Nosy Bé; J. Rudloe, col.; IIOE; January-February 1964; USNM.

Diagnosis.—Eye very small, cornea set transversely on stalk; corneal indices 514–690; rostral plate quadrangular or subtriangular; anterolateral spines of carapace strong; median carina of carapace with anterior bifurcation open for half or more of its length; dactylus of raptorial claw with 6 teeth, outer margin of dactylus sinuate; dorsal ridge of carpus with 2–3 tubercles; inferodistal angle of merus of claw armed; mandibular palp and 4 epipods present; lateral processes of fifth to seventh thoracic somites bilobed; abdominal carinae spined as follows: submedian, (3) 4–6; intermediate, (2–3) 4–6; lateral, 1–6; marginal, 1–5; denticles, 1–3, 7–9, 1, rounded; ventral surface of telson with postanal keel.

Color.—Entire body dusky, appearing mottled; carinae green in preservative; some specimens with transverse patch of dark pigment on second abdominal somite; distal portions of uropod dark, except for distal segment of exopod, which is light with dark edges.

Discussion.—The present specimens agree well with accounts of the species in the literature. In shape of rostral plate and spination of the abdomen they show an unusual amount of variation. The

Figure 10.—*Squilla nepa* Latreille, female, TL 85.8, Baie Narendry: anterior portion of body.

rostral plate may be triangular or subquadrate, with the apex transverse or rounded. In one specimen the plate is very short and broadly rounded. The submedian carinae of the third abdominal somite are armed in about half the specimens; the spines may be present on large or small specimens. The intermediate carinae of the second and third somites may be armed.

Distribution.—Western portion of Indo-West Pacific region, from the western Indian Ocean and South Africa to Hong Kong.

Acanthosquilla Manning, 1963

Four species of *Acanthosquilla* have been recorded from the Indo-West Pacific region and one new species is described herein. The following key will distinguish the five species, of which all but one, *A. tigrina* (Nobili), occurs in the western Indian Ocean.

Key to Indo-West Pacific Species of *Acanthosquilla*

1. Telson with 4 pairs of fixed marginal teeth 2
   Telson with 2 pairs of fixed marginal teeth 4
2. Ventral margin of sixth abdominal somite with posterior spines. **A. tigrina** (Nobili, 1903)
   Ventral margin of sixth abdominal somite unarmed 3
3. Rostral plate trispinous; dactylus of claw with 10–11 teeth; submedian denticles arranged in semicircle . . . . . **A. vicina** (Nobili, 1904)
   Rostral plate angled anterolaterally, with median spine; dactylus of claw with 7 teeth; submedian denticles in transverse row . . **A. humesi,** new species
4. Lobes on outer margin of dactylus subequal; submedian denticles in transverse row; first and third intermediate denticles larger than second and fourth . . . . . **A. acanthocarpus** (Miers, 1880)
   Distal lobe on outer margin of dactylus much larger than proximal; submedian denticles in oblique row; second and fourth intermediate denticles larger than first and third . . . . . **A. multifasciata** (Wood-Mason, 1895)

Acanthosquilla humesi, new species

FIGURE 11

Acanthosquilla Humes, 1965, p. 184.

HOLOTYPE.—1 ♀, 62.5; Ambatozavary, Nosy Bé, Madagascar; E. Cutler; 16 July 1964; USNM 124095.

PARATYPES.—1 ♂, 63.2; 1 ♀, 64.5; Antsakoabe, northwestern shore of Nosy Bé, Madagascar; dug from 30 cm intertidal sand; A. G. Humes; host no. 889; 12 July 1964; USNM 124096.

DESCRIPTION.—Eye small, not extending to end of antennular peduncle; cornea subglobular, slightly larger than and set obliquely on stalk; ocular scales small, erect, bases fused, apices divergent.

Antennular peduncle short, less than half as long as carapace; dorsal processes of antennular somite visible on either side of rostral plate as a slender, anteriorly directed spine.

Antennal peduncle with 1 mesial and 1 ventral papilla; antennal scale short, less than half as long as carapace.

Rostral plate trapezoidal, narrowed anteriorly, angled anterolaterally, with slender median spine; anterior portion of median spine resting in apex of V formed by ocular scales.

Carapace narrowed anteriorly, rounded anterolaterally and posteriorly, lacking spines, carinae, or cervical groove.

Raptorial claw stout, dactylus with 7 teeth, penultimate shorter than antepenultimate; base of dactylus with proximal angled projection and distal obtuse projection separated by a shallow concavity; propodus with 4 proximal movable spines and normal pectination; dorsal ridge of carpus terminating in slender spine; merus much longer than ischium.

273-102—67——3

Propodi of third and fourth thoracic appendages broader than long, with ventral ribbing; propodus of fifth appendages as broad as long, with inferior brush of setae.

Mandibular palp and 5 epipods present.

Exposed thoracic somites smooth, lateral margins rounded or subtruncate; basal segment of each walking leg unarmed; endopods of

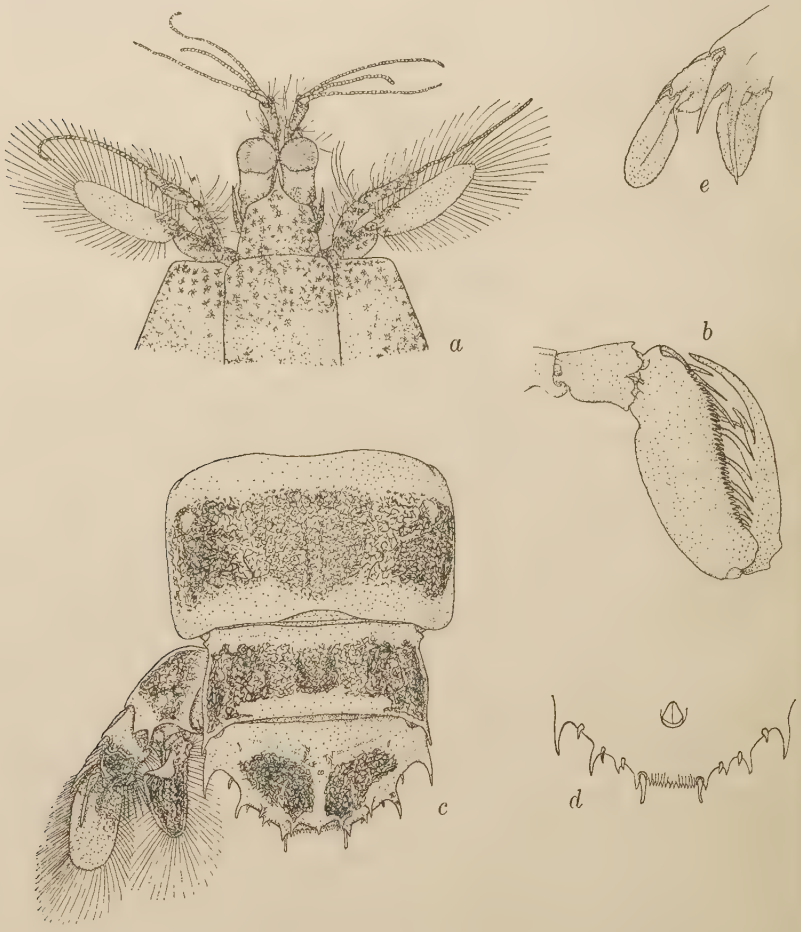

FIGURE 11.—*Acanthosquilla humesi*, new species, female holotype, TL 62.5, Nosy Bé: *a*, anterior portion of body; *b*, raptorial claw; *c*, last two abdominal somites, telson, and uropod; *d*, telson, ventral view; *e*, uropod, ventral view (setae omitted).

walking legs 2-segmented, subcircular on first 2 legs, ovate on last; eighth somite without noticeable ventral keel.

Abdomen depressed, somites broad, smooth, unarmed except for slender posterolateral spines on sixth; sixth somite with prominent

ventral projections overhanging articulation of uropod, each armed with accessory spinule; ventral surface of sixth abdominal somite unarmed.

Telson broader than long, with normal dorsal fan of 5 teeth; marginal armature consisting of, on either side of the midline, 1 movable submedian tooth and 4 fixed teeth, inner overhanging movable submedians; 6–7 submedian denticles present, with 1 denticle present between each of the other marginal teeth.

Uropod with 7 slender movable spines present on outer margin of proximal segment of exopod, last extending to midlength of distal segment; 9–13 stiff setae present on inner distal lobe of proximal segment of exopod; endopod triangular, with prominent fold on inner, proximal margin; spines of basal prolongation trefoil in cross section, inner longer than outer.

Color.—Rostral plate, eyestalks, anterior appendages, and dorsal surface of claws with scattered dark spots; carapace with 3 transverse black bands plus dark crescent at each posterolateral angle; last 3 thoracic and all 6 abdominal somites with broad, transverse black band; telson with 4 oval dark patches, interrupted at midline and between second and third dorsal teeth on each side; uropodal exopod with black spot at articulation of distal segment, inner angle of distal segment dark; endopod black.

Size.—Only male known, TL 63.2; females, TL 62.5–64.5. Other measurements of female paratype: carapace length 10.6; cornea width 1.6; rostral plate length 3.1, width 3.4; fifth abdominal somite width 11.1; telson length 5.0, width 8.8.

Discussion.—*A. canthosquilla humesi* can be distinguished from both *A. acanthocarpus* (Miers) and *A. multifasciata* (Wood-Mason) by the presence of four fixed marginal teeth on the telson; the latter two species both have but two fixed spines. *Acanthosquilla humesi* agrees with *A. tigrina* (Nobili) and *A. vicina* (Nobili) in having four pairs of fixed marginal teeth on the telson but may be readily distinguished from both of those species. It lacks the posterior ventral spines on the sixth abdominal somite that are characteristic of *A. tigrina*, and it differs from *A. vicina* in having a single median spine on the rostral plate, fewer spines on the claw (seven instead of 10–11), and in having the submedian denticles of the telson arranged in a transverse row rather than in a semicircle.

These specimens were the hosts of a cyclopoid copepod, *Hemicyclops acanthosquillae* Humes, collected and described by Arthur G. Humes (1965). This, I believe, is the first recorded occurrence of a copepod-stomatopod association.

Humes (1965, p. 184) noted that the stomatopods appeared in the water seeping into a hole 30 cm deep that had been dug in clear sand.

Etymology.—The species is named for the collector, Arthur G. Humes.

Distribution.—Known only from Nosy Bé, Madagascar.

Lysiosquilla Dana, 1852

Only two species of *Lysiosquilla* have been recognized from the Indo-West Pacific region in recent years, *L. capensis* Hansen, 1895, and *L. maculata* (Fabricius, 1793). Two varietal forms of the latter species, *L. m.* var. *sulcirostris* Kemp, 1913 and *L. m.* var. *tredecimdentata* Holthuis, 1941, also have been recognized. All four of these forms are distinct species that may be distinguished by means of the key below.

A redescription of *L. capensis* Hansen is in preparation.

Two species of *Lysiosquilla, maculata* and *tredecimdentata,* occur off Madagascar.

Key to Indo-West Pacific Species of *Lysiosquilla*

1. Rostral plate triangular, greatest width at base; median carina of plate flanked by longitudinal grooves; dactylus of claw with 8 teeth. **L. sulcirostris** Kemp, 1913
   Rostral plate cordiform, greatest width in advance of base; median carina of plate, when present, not flanked by longitudinal grooves; dactylus of claw with more than 8 teeth 2
2. Antennal scale oval, less than twice as long as broad; anterior margin of antennal protopod lacking projection; ventral keel of eighth thoracic somite rounded . . . . . **L. maculata** (Fabricius, 1793)
   Antennal scale slender, elongate, more than twice as long as broad; anterior margin of antennal protopod with projection; ventral keel of eighth thoracic somite acute, sharp, posteriorly 3
3. Rostral plate lacking median carina; ventral surface of uropodal protopod with slender spine at articulation of endopod . . **L. capensis** Hansen, 1895
   Rostral plate with median carina; ventral surface of uropodal protopod lacking spine at articulation of endopod . . **L. tredecimdentata** Holthuis, 1941

Lysiosquilla maculata (Fabricius, 1793)

Figure 12

Lysiosquilla (*Miers*) *maculata.*—Lenz and Richters, 1881, p. 428.

Lysiosquilla maculata.—Kemp, 1913, p. 111, pl. 8 (fig. 89–91) [older references].—Monod, 1925, pl. xxi (fig. d).—Holthuis, 1941, p. 269, fig. 5.—Barnard, 1950, p. 855, figs. 3d, 4c–d.—Serène, 1954, pp. 6, 8, 11, 13, 64, 66, fig. 12, pl. 5 (figs. 1–2), pl. 6 (figs. 1–2).—Kurian, 1954, p. 86.—Stephenson and McNeil, 1955, p. 246.—Manning, 1962, p. 2; 1967, p. 103.

Lysiosquilla maculata maculata.—Ingle, 1963, p. 23, figs. 23, 45, 61, 72 [part; not specimen from Gulf of Aden].

Previous records.—Lenz and Richters, 1881; Monod, 1925.

Material.—1 ♀, 146.0; Nosy Bé, Madagascar; intertidal zone; A. Crosnier; May 1960; USNM.

DESCRIPTION.—Eye large, cornea bilobed, set almost transversely on stalk; eyes not extending beyond end of second segment of antennular peduncle; ocular scales triangular, apices acute, curved anteriorly; corneal index 362.

Antennular peduncle short, about half as long as carapace; dorsal processes of antennular somite visible lateral to rostral plate as anteriorly directed spines.

Antennal scale broad, ovate, more than twice as long as broad; antennal peduncle extending to or slightly beyond eye; basal portion of antenna with anterior margin straight, not produced into an anterior triangular projection or spine, and with 3 papillae, 1 mesial, 2 ventral.

Rostral plate cordiform, broader than long, apex deflexed; median carina present on anterior half.

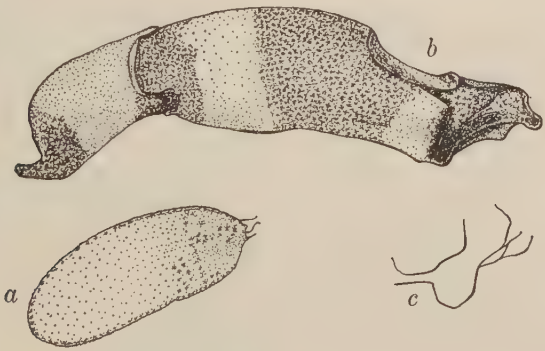

FIGURE 12.—*Lysiosquilla maculata* (Fabricius), female, TL 146.0, Nosy Bé: *a*, antennal scale (setae omitted); *b*, color pattern of ischium and merus of raptorial claw; *c*, outline of ventral keel of eighth thoracic somite.

Dactylus of raptorial claw with 9–11 teeth (10 in present specimen), outer margin of dactylus sinuate; propodus with few hairs proximally; dorsal ridge of carpus terminating in single spine, apex not deflexed.

Mandibular palp and 5 epipods present.

Ventral keel of eighth thoracic somite low, rounded, unarmed.

Abdomen smooth, unarmed; sixth somite with irregular submedian area separated from smooth lateral boss by a longitudinal sulcus; sixth somite with slender, triangular projection in front of articulation of each uropod.

Telson much broader than long, pitted dorsally, with low, raised triangular median boss and 2 lower, oval, submedian bosses on dorsal surface; posterior margin with 4 pairs of projections, outer 2 best developed.

Basal segment of uropod with dorsal spine; proximal segment of exopod with 8 slender, movable spines, last not extending to midlength of distal segment; distal segment of exopod longer than proximal; endopod broad, triangular, twice as long as broad; basal prolongation consisting of 2 spines, trefoil in cross section, inner longer; ventral surface of uropodal protopod unarmed at articulation of endopod.

Color.—Body with dark bands, pattern variable (see illustration in Kemp, 1913); carapace with 3 dark bands, body with dark band at articulation of each somite; antennal scale with 1–2 dark patches, not outlined with dark pigment; claw conspicuously banded with dark pigment; basal portion of first walking leg light, of last 2 dark; sixth abdominal somite light dorsally; telson with median and 2 submedian dark parches, connected anteriorly; basal segment of uropod dark proximally; distal half of distal segment clear; most of distal portion of endopod dark.

Size.—Only specimen examined, female, TL 146.0. Other measurements: carapace length 26.4; cornea width 7.3; rostral plate length 5.3, width 5.9; antennal scale length 16.5, width 7.1; fifth abdominal somite width 30.5; telson length 20.2, width 28.6.

Discussion.—The unarmed antennal and uropodal protopods, broad rostral plate, broad antennal scale, and characteristically barred claw will distinguish this species from others in the genus.

Distribution.—Widely distributed in the Indo-West Pacific, from numerous localities between the western Indian Ocean and Hawaii.

Lysiosquilla tredecimdentata Holthuis, 1941

Figure 13

?*Lysiosquilla maculata*.—Chopra, 1939, p. 16.
Lysiosquilla maculata var. *tredecimdentata* Holthuis, 1941, p. 273, fig. 6.
Lysiosquilla maculata tredecimdentata.—Manning, 1963, p. 317 [listed].
?*Lysiosquilla maculata maculata*.—Ingle, 1963, p. 23 [part; reference to specimen from Gulf of Aden only].

Previous records.—None.

Material.—1 ♂, 161.7; Estuaire du Mangoky, western coast of Madagascar; trawl; 9 m; grey mud, sand; A. Crosnier; June 1959; USNM.

Description.—Eye large, cornea bilobed, set almost transversely on stalk; eye not extending beyond end of second segment of antennular peduncle; ocular scales subtriangular, flattened dorsally, apices acute, directed anteriorly; corneal index 354.

Antennular peduncle short but more than half as long as carapace; dorsal processes of antennular somite visible lateral to rostral plate as anteriorly directed spines.

Antennal scale slender, curved, more than 3 times as long as broad; antennal peduncle not extending beyond eye; basal portion of antenna with anterior triangular projection, directed anterolaterally, and with 3 papillae, 1 mesial, 2 ventral.

FIGURE 13.—*Lysiosquilla tredecimdentata* Holthuis, male, TL 161.7, Mangoky estuary: *a*, anterior portion of body; *b*, color pattern of ischium and merus of raptorial claw; *c*, outline of ventral keel of eighth thoracic somite; *d*, last abdominal somite, telson, and uropod. (Setae omitted).

Rostral plate cordiform, broader than long, apex deflexed; median carina present on anterior half.

Raptorial claw with 10 teeth (12–13 on other specimens), outer margin of dactylus sinuate; propodus with some proximal hairs, as in female *L. maculata;* dorsal ridge of carpus terminating in a single spine, deflexed mesioventrally.

Mandibular palp and 5 epipods present.

Ventral keel of eighth thoracic somite produced into a posteriorly directed spine.

Abdomen smooth, unarmed; sixth somite with irregular submedian area separated from longitudinal lateral boss by a longitudinal sulcus; sixth somite with blunt triangular projection in front of articulation of each uropod.

Telson much broader than long, pitted dorsally, with low, raised triangular median boss and 2 lower oval submedian bosses on dorsal surface; posterior margin with 4 pairs of projections, outer 2 best developed.

Basal segment of uropod with dorsal spine; proximal segment of exopod with 9 slender, movable spines on outer margin, last not extending to midlength of distal segment; distal segment of exopod longer than proximal; endopod broad, triangular, over twice as long as wide; basal prolongation consisting of 2 spines, trefoil in cross section, inner longer; ventral surface of uropodal protopod unarmed at articulation of endopod.

Color.—Body with dark bands, as in *L. maculata;* carapace with 3 dark bands and body with broad, dark band at articulation of each somite; claw lacking prominent dark bars, distal half of merus and proximal half of propodus with dark flush; basal fourth of all walking legs dark; sixth abdominal somite dark; telson with broad, transverse dark patch, most of distal margin lighter; basal segment of uropod dark; distal half of proximal segment and proximal half of distal segment of uropodal exopod dark, distal half of distal segment light; most of distal portion of uropodal endopod dark.

Size.—Single male examined, TL 161.7. Other measurements: carapace length 28.3; cornea width 8.0; rostral plate length 6.4, width 7.4; antennal scale length 17.2, width 5.4; fifth abdominal somite width 35.2; telson length 21.8, width 32.0.

Discussion.—The slender antennal scale, outlined in dark pigment, the anterior projection on the basal portion of the antenna, the lack of dark bands on the claw, the deflexed spine on the carpus of the claw, the triangular keel on the eighth thoracic somite, and the unarmed ventral surface of the uropodal protopod will distinguish this species from all others in the genus.

Lysiosquilla tredecimdentata has not been recorded previously from outside the Gulf of Aden. I have compared this specimen, a male, with three females taken at Aden Harbor during the International Indian Ocean Expedition. It differs in having a larger eye, which is broader than the rostral plate, and in having fewer teeth, 10 instead of 12, on the dactylus of the claw. I have assumed that these are sexual differences, for in all other respects the four specimens are almost identical, even to overall color pattern.

Chopra (1939) noted that his specimen of *L. maculata* from the Gulf of Aden had 12 teeth on the dactylus of the claw, an unusually high number for *L. maculata*. All the specimens of *L. tredecimdentata* from the Gulf of Aden examined by me had 12 teeth on the claw. It seems likely that Chopra was dealing with *L. tredecimdentata* not *L. maculata*. Ingle (1963) also listed the occurrence of the same specimen previously recorded by Chopra.

The single male specimen from Madagascar shows some trace of the hairs on the propodus of the raptorial claw characteristic of adult females of *L. maculata*. There is no apparent reduction in size of the claw or in size and number of teeth.

Distribution.—Western Indian Ocean, from Aden (?Chopra, 1939; Holthuis, 1941; ?Ingle, 1963) and from Madagascar.

Odontodactylus Bigelow, 1893

Three species of this genus are known to occur in the Indian Ocean, and two of these are recorded below from Madagascar. *Odontodactylus brevirostris* (Miers), which is not represented in the present collection, has been reported from the Seychelle Islands and from Providence Island (Miers, 1884; Borradaile, 1907; Manning, 1967a) and could be expected off Madagascar.

The three specimens reported below were included by me in a review of the genus *Odontodactylus*, which contained complete accounts for each of the five known species.

Odontodactylus japonicus (de Haan, 1844)

Odontodactylus japonicus.—Kemp, 1913, p. 139.—Manning, 1967a, p. 7, fig. 2 [other references].

Illustration.—Manning, 1967a, fig. 2.

Previous records.—Ambovombe (Manning, 1967a).

Material.—1 ♀, 117.0; Ambovombe, southern coast of Madagascar; 60 m; shelly sand; A. Crosnier; 8 October 1958; USNM.

Remarks.—This specimen was recorded by Manning (1967a).

Distribution.—Indo-West Pacific, from two localities in the Indian Ocean, Seychelles (Borradaile, 1907) and Madagascar (Mann-

ing, 1967a), and from locations around China and Japan. In moderate depths, to 200 m.

Odontodactylus scyllarus (Linnaeus, 1758)

Gonodactylus scyllarus.—Miers, 1880, p. 115.—Richters, 1880, p. 167.
Odontodactylus scyllarus.—Kemp, 1913, p. 135.—Manning, 1967a, p. 10, fig. 3 [other references].

ILLUSTRATION.—Manning, 1967a, fig. 3.

PREVIOUS RECORDS.—Miers, 1880; Richters, 1880; Manning, 1967a.

MATERIAL.—1 ♀, 131.0; Nosy Bé, Madagascar; P. Fourmanoir; MNHNP. 1 broken ♂, CL 36.0; same; A. Crosnier; USNM.

REMARKS.—These specimens were reported by Manning (1967a).

DISTRIBUTION.—Indo-West Pacific, from the western Indian Ocean to Japan. Shallow water.

Pseudosquilla Dana, 1852

Pseudosquilla ciliata (Fabricius, 1787)

Pseudosquilla ciliata.—Lenz, 1910, p. 571.—Kemp, 1913, p. 96 [older references].—Holthuis, 1941, p. 261 [older references].—Barnard, 1950, p. 852, fig. 3a.—Serène, 1951, p. 11, figs 1–6, 8–1; 1954, pp. 6, 10.—Stephenson and McNeill, 1955, p. 245.—Manning, 1962, p. 2.—Ingle, 1963, p. 21, figs. 18, 39, 52, 68.

ILLUSTRATION.—Serène, 1951, figs. 1–6, 8–1.

PREVIOUS RECORDS.—Sainte Marie (Lenz, 1910); Fort Dauphin (Gravier, 1935).

MATERIAL.—1 ♀, 36.8; Nosy Bé, Madagascar; intertidal zone; A. Crosnier; September 1958; USNM. 1 ♂, 37.7; Nosy lava (?); A. Crosnier; MNHNP. 1 ♂, 37.8; 1 ♀, 24.2; Banc de Pracel, western coast of Madagascar; 55 m; muddy sand; June 1959; USNM. 1 ♀, 80.3; Anjouan Id., Comoro Ids.; A. Crosnier; USNM. 1 ♀, 63.8; Anjouan Id., Comoro Ids.; from stomach of *Caranx;* A. Crosnier; MNHNP. 1 postlarva, 17.9; Mayotte Id., Comoro Ids.; 47 m; sand; A. Crosnier; August 1959; MNHNP. 1 ♀, 20.0; same; 51 m; coarse sand; A. Crosnier; 1 October 1959; MNHNP.

REMARKS.—All specimens correspond to the "forme claire" discussed by Serène (1951).

DISTRIBUTION.—Widely distributed in the Atlantic and Indo-West Pacific Oceans.

Gonodactylus Berthold, 1827

The Indo-West Pacific species of *Gonodactylus* fall into three distinct groups or sections, one centered around *G. chiragra* (Fabricius), one around *G. falcatus* (Forskål), and one around *G. demanii* Henderson.

The "*chiragra* section" includes large species with broad ocular scales and with three large carinae on the median dorsal surface of the

telson. Species in this section include the three species reported below, *G. chiragra* (Fabricius), *G. platysoma* Wood-Mason, and *G. smithii* Pocock. It is suggested below that *G. acutirostris* de Man is based on an aberrant specimen, and that de Man's species is conspecific with *G. smithii*.

The "*falcatus* section" includes only two species, *G. falcatus* (Forskål) and *G. graphurus* Miers; these species have small ocular scales and five carinae on the median area of the telson. Manning (1966) and others have pointed out that the latter species does not occur west of Indo-Malaya and that earlier records to it in the literature from the western Indian Ocean are referable to *G. falcatus*.

The "*demanii* section" includes 10 small species, mature at TL 50 mm or less, seven of which were reported by Manning (1967b). Three additional species are reported below from Madagascar, including one species revived from the synonoymy of *G. chiragra* and two described as new.

Gonodactylus chiragra (Fabricius, 1781)

Gonodactylus chiragra.—Lenz and Richters, 1881, p. 428.—Kemp, 1913, p. 155, fig. 2 on p. 161, pl. 9 (fig. 107).—Gravier, 1920, p. 377; 1935, p. 358.—Holthuis, 1941, p. 277, fig. 7 [older references].—Poisson, 1949, p. 23.—Barnard, 1950, p. 861.—Fourmanoir, 1952, p. 171; 1953, p. 157.—Serène, 1954, pp. 6, 10, 11, 27, 42, 74, 84, figs. 9–10, 13–1, 13–2, 15, pl. 7.—Stephenson and McNeill, 1955, p. 250.—Manning, 1965, p. 2; 1966, p. 113; 1967, p. 102.

Not *Gonodactylus chiragra chiragra*.—Ingle, 1963, p. 27, figs. 27, 47, 63. [=*G. smithii* Pocock?]

Illustration.—De Man, 1898, pl. 38 (fig. 77); Kemp, 1913, fig. 1 on p. 161.

Previous records.—Fort Dauphin (Gravier, 1935); Ile Europa (Fourmanoir, 1952); no specific locality (Lenz and Richters, 1881; Gravier, 1920; Poisson, 1949; Fourmanoir, 1953).

Material.—1 broken ♀, CL 13.9; Mayotte Island, Comoro Islands; reef flat; L. S. Kornicker, Sta. LK-39; *Anton Bruun* Cruise 9, IIOE; 24 November 1964; USNM. 1 ♀, 48.3; Nosy Bé, Madagascar; A. Crosnier; 10 December 1958; MNHNP. 1 ♂, 83.5; Nosy Bé; under dead coral debris; Mme. Chavane; 18 September 1958; MNHNP. 1 ♂, 70.9; 2 ♀, 48.4–68.9; Nosy Bé; in sandstone; 20 May 1958; MNHNP. 4 ♂, 31.8–55.7; 5 ♀, 22.8–72.1; Nosy Bé; sandstone; A. Crosnier; November 1961; USNM. 1 ♂, 70.5; Ambatoloaka, Nosy Bé; Mme. Chavane; 25 September 1964; USNM. 8 ♂, 22.4–88.4; 3 ♀, 41.9–67.3; Pt. Fièvre, Nosy Bé; 13°24′21″ S, 48°18′33″ E; J. Rudloe, field no. Jr–13; IIOE; 26 December 1963; USNM. 2 ♂, 50.3–51.2; Ambatomboka (?) Crater Point, Nosy Bé; 13°24′17″ S, 48°13′31″ E; taken from base of volcanic rocks; J. Rudloe, Field no. JR–23; IIOE; 3 January 1964; USNM. 1 ♂, 44.1; 1 ♀, 51.6; 50 yds.

right of Centre d'Océanographie pier, Pt. Fièvre, Nosy Bé; 13°24.4′ S, 48°17.8′ E; intertidal mud flat, mud, rock; J. Rudloe, field no. 24A; IIOE; 4 January 1964; USNM. 1 ♂, 105.5; mud flats of Ambatozavavy, Nosy Bé; 13°22′10″ S, 48°19′52″ E; J. Rudloe, field no. JR-52; IIOE; 29 January 1964; USNM. 1 ♂, 42.7; Tani Keli (Tany Kely), Nosy Bé; 13°26′36″ S, 48°14′48″ E; J. Rudloe, field no. JR-62; IIOE; USNM. 1 ♂, 21.3; 3 ♀, 68.5–73.2; Nosy Bé; J. Rudloe, field no. JR-63-1; IIOE; 17 December 1963; USNM. 1 ♂, 51.3; 2 ♀, 67.4–69.2; Nosy Bé; J. Rudloe, field no. JR-63-2; IIOE; USNM.

Distribution.—Widely distributed in the Indo-West Pacific region, from the western Indian Ocean through Oceania.

Gonodactylus platysoma Wood-Mason, 1895

Gonodactylus chiragra var. *acutus* Lanchester, 1903, p. 447, pl. 23 (figs. 2, 3, 3a).—Lenz, 1910, p. 571.

Gonodactylus chiragra var. *tumidus* Lanchester, 1903, p. 447, pl. 23 (figs. 1, 1a).—Lenz, 1910, p. 571.

Gonodactylus chiragra var. *platysoma*.—Kemp. 1913, p. 162, fig. 1 on p. 161.—Bigelow, 1931, p. 117, pl. 1 (fig. 2), pl. 2 (fig. 2).—Holthuis, 1941, p. 281.

Gonodactylus platysoma.—Serène, 1954, pp. 10, 74, fig. 13–4.—Manning, 1962, p. 3; 1966, p. 110; 1967, p. 103.

Gonodactylus chiragra platysoma.—Ingle, 1963, p. 25 [key].

Illustration.—Bigelow, 1931, pl. 1 (fig. 2), pl. 2 (fig. 2).

Previous records.—Tamatave, Sainte Marie, Angontil (Lenz, 1910).

Material.— 1 ♂, 72.8; Mayotte Id., Comoro Islands; intertidal zone; A. Crosnier; September 1959; MNHNP. 1 ♂, 59.7; Anjouan Id., Comoro Islands; intertidal zone; A. Crosnier; November 1961; USNM.

Remarks.—The specimen from Anjouan Island has two commensal gastropods attached to the pleopods. Holthuis (1951) has commented on the occurrence of a gastropod, *Caledoniella montrouzieri* Souverbie, on specimens of *Gonodactylus chiragra*. As far as I can determine, no commensals have been reported for *G. platysoma*.

Distribution.—Indo-West Pacific, from scattered localities between the western Indian Ocean and Oceania.

Gonodactylus smithii Pocock, 1893

Gonodactylus smithii Pocock, 1893, p. 475, pl. 20B (fig. 1).—Serène, 1954, pp. 6, 7, 10, 74, 76, fig. 13–5, pl. 8.—Manning, 1966, p. 112.

Gonodactylus chiragra var. *acutirostris* de Man, 1898, p. 695, pl. 38 (figs. 77b, c).—Lanchester, 1903, p. 454.—Gravier, 1937, p. 204, fig. 20.

Gonodactylus chiragra var. *smithii*.—Borradaile, 1898, p. 33, 35.—Lanchester, 1903, p. 447, pl. 23 (figs. 4–5).—Lenz, 1905, p. 387.—Tattersall, 1906, p. 167.—Borradaile, 1907, p. 211 [key], p. 212.—Lenz, 1910, p. 571.—Rathbun, 1914, p. 664.

Gonodactylus chiragra var. c (*acutirostris*).—Borradaile, 1899, pp. 400, 401, 402.
Gonodactylus chiragra var. D (*smithi*).—Borradaile, 1899, p. 402.
Gonodactylus chiragra.—Lanchester, 1901, p. 555.—Nobili, 1906, p. 157 [part]. Tattersall, 1921, p. 359 [*smithii* in discussion].
Gonodactylus acutirostris.—Borradaile, 1907, p. 210 [key].—Kemp, 1913, p. 163.—Serène, 1947, p. 382, fig. 1, pl. 1.—Dawydoff, 1952, p. 145.—Serène, 1953, pp. 506, 507.
Gonodactylus chiragra var. *intermedia* de Man, 1929, p. 25, pl. 3 (figs. 9–9b); 1929a, p. 3.
?*Gonodactylus chiragra chiragra*.—Ingle, 1963, p. 27, figs. 27, 47, 63 [part?].

Illustration.—Serène, 1947, fig. 1, pl. 1.

Previous records.—None.

Material.—1 ♂, 38.9; Mayotte Id., Comoro Islands; reef flat; L. S. Kornicker, Sta. LK–39; *Anton Bruun* Cruise 9, IIOE; 24 November 1964; USNM. 1 ♀, 29.4; Anjouan Id., Comoro Islands; intertidal zone; A. Crosnier; November 1961; USNM. 1 ♀, 41.0; Nosy Bé, Madagascar; in sandstone; 20 May 1958; MNHNP. 1 ♀, 30.2; Banc de l'Etoile, Madagascar; dredge; 20–80 m; A. Crosnier; May 1960; MNHNP. 1 ♂, 34.7; 1 ♀, 41.7; Tulear, Madagascar; A. Crosnier; October 1958; USNM. 1 ♂, 50.0; 2 ♀, 44.4–48.2; Tulear; from offshore reef; K. J. Boss; *Anton Bruun* Cruise 7, IIOE; 9 August 1964; USNM.

Discussion.—I believe Lanchester (1903) was correct in suggesting that *G. acutirostris* de Man was based on a specimen with a damaged telson, with the deformity affecting the posterior end of the median carina and the anterior ends of the carinae of the submedian teeth. In other respects, including the sharpness of carinae on the telson and the acute anterolateral angles of the rostral plate, it agrees with *G. smithii* Pocock. There is little doubt in my mind that *G. chiragra* var. *intermedia* de Man, from Pulau Berhala, is conspecific with *G. smithii;* it agrees with the latter species in all respects.

Odhner (1923) pointed out that Kemp (1913), in his account of *G. acutirostris*, misunderstood de Man's original description in stating that *G. acutirostris* lacked the anterior tubercles on the telson; Odhner pointed out that these tubercles were present, but that the type lacked the flukes of the anchor. In my account of *G. smithii* (1966) from Australia, I made the same error in pointing out differences between my specimens and *G. acutirostris*. De Man (1929) noted that in the type of *G. acutirostris* the anterior tubercles were present.

Specimens of *G. smithii* from Australia differ from those reported here in having a broader endopod on the uropod, on which the inner margin is convex. In the specimens from Madagascar the inner margin of the uropodal endopod is sinuous, convex proximally, concave distally.

One of the male specimens from Tulear has two gastropod molluscs attached to the body, a large one on the pleopods and a smaller one on the ventral surface of the eighth thoracic segment. As noted under *G. platysoma*, commensal gastropods have been reported only for *G. chiragra*.

Distribution.—Indo-West Pacific, from the western Indian Ocean to Viet Nam and Australia. Shallow water to 50 fms.

Gonodactylus falcatus (Forskål, 1775)

Gonodactylus glabrous.—Kemp, 1913, pp. 167, 197, fig. 2 on p. 170, pl. 9 (fig. 113) [older references].—Barnard, 1950, p. 863, fig. 3f.

Gonodactylus falcatus.—Holthuis, 1941, p. 284, fig. 9a.—Serène, 1954, pp. 6, 7, 10, 11, 42, 77, figs. 8, 13–6, pl. 9.—Stephenson and McNeill, 1955, p. 249.—Manning, 1962, p. 4.—Ingle, 1963, p. 29, figs. 28, 57.—Manning, 1965, p. 260; 1966, p. 109; 1967, p. 102.

Illustration.—Brooks, 1886, pl. 14 (fig. 5).

Previous records.—None.

Material.—1 ♀, 21.1; Mayotte Id., Comoro Islands, reef flat; L. S. Kornicker, Sta LK–39; *Anton Bruun* Cruise 9, IIOE; 24 November 1964; USNM. 1 ♂, 35.9; 1 ♀, 22.8; Ile Europa, off Madagascar; A. Crosnier; MNHNP. 1 ♂, 63.3; Iles Mitsio, northwestern coast of Madagascar; trawl; 26 m; sand; A. Crosnier; June 1959; MNHNP. 2 ♂, 33.8–54.5; 11 ♀, 37.7–71.6; Sud Mitsio, northwestern coast of Madagascar; trawl; 26 m; sand; A. Crosnier; June 1959; USNM. 1 ♂, 20.3; Banc de Pracel, western coast of Madagascar; 50 m; muddy sand; A. Crosnier; June 1959; MNHNP.

Distribution.—Indo-West Pacific region, from Red Sea and South Africa to Japan.

Gonodactylus bicarinatus, new species

Figure 14

Holotype.—1 ♀, 26.7; Nosy Bé, Madagascar; intertidal zone; A. Crosnier; October 1959; USNM 124097.

Description.—Anterior margins of rostral plate straight, anterolateral angles rounded.

Ocular scales small, erect.

Mandibular palp and 5 epipods present.

Lateral processes of sixth and seventh thoracic somites subtruncate, rounded laterally, subequal.

Carinae of sixth abdominal somite not markedly inflated, each with apical spine.

Telson broader than long, with 3 pairs of slender, sharp marginal teeth, laterals well developed; dorsal surface of telson with numerous spinules and tubercles, smaller and more abundant on anterior carinae than on carinae of marginal teeth; median carina oval, very inflated,

with 1–2 irregular marginal rows of tubercles, apical spine largest, median surface smooth; anterior submedian carinae with 1–2 dorsal spinules, 1 distal spine, and distolateral patch of spinules; knob with 3 spinules; anterior surface of telson with rounded lobe, each tuberculate, at level of intermediate carinae of sixth somite; carinae of submedian and intermediate marginal teeth each ornamented with numerous large spines; numerous small submedian and 2 sharp intermediate denticles present; outer intermediate denticle recessed ante-

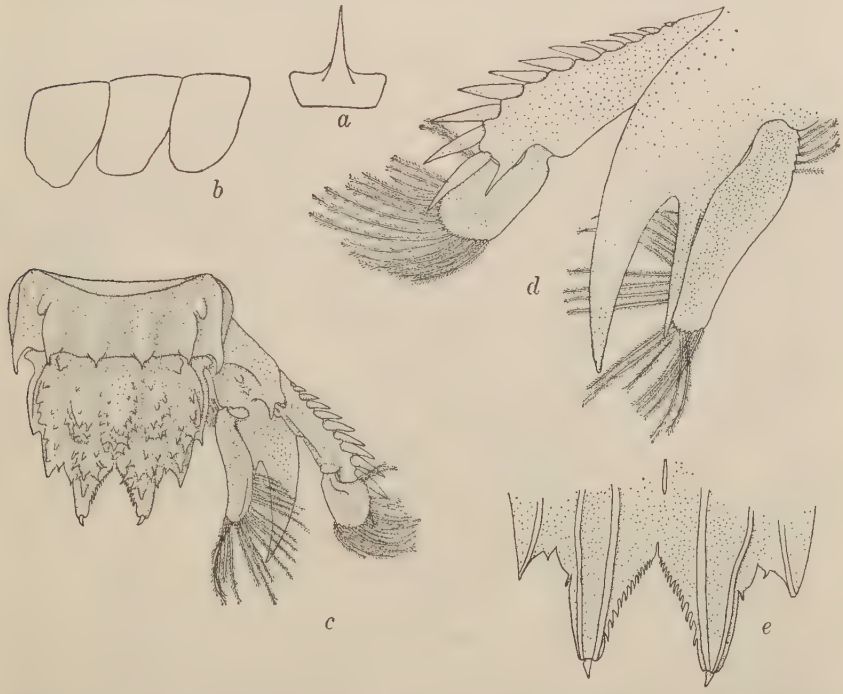

FIGURE 14.—*Gonodactylus bicarinatus*, new species, female holotype, TL 26.7, Nosy Bè: *a*, outline of rostral plate; *b*, outline of lateral processes of sixth, seventh, and eighth thoracic somites, right side; *c*, last abdominal somite, telson, and uropod; *d*, uropod, ventral view, enlarged; *e*, submedian teeth of telson, ventral view, enlarged.

riorly, inner denticle appressed to margin of submedian tooth, apex at level of intermediate tooth; ventral surface of telson with longitudinal carinae, including a short postanal keel, 2 sharp, long carinae on each submedian tooth, and 1 shorter, less distinct carina on each intermediate tooth.

Proximal segment of uropod with 2 sharp, dorsal tubercles mesial to dorsal carina; uropod setation reduced; most of inner margin of proximal segment of exopod smooth, a few small proximal setae present; proximal segment of exopod with fixed ventrodistal spinule

overhanging articulation of distal segment; distal segment of exopod smooth mesially, distolateral setae present; endopod slender, sinuous, most of inner margin smooth, lacking setae, 4–5 small, proximal setae present; distolateral margins of endopod with normal complement of setae; inner spine of basal prolongation slenderer and shorter than outer.

Color.—Traces of dark chromatophores present across posterior third of carapace, sixth thoracic somite, and first, third, fourth, and fifth abdominal somites, pattern most visible on first abdominal somite; telson with dark spots along anterior margin.

Size.—Female, TL 26.7. Other measurements: carapace length 5.2; fifth abdominal somite width 4.5; telson length 3.1, width 3.5.

Discussion.—*G. bicarinatus* closely resembles *G. demanii* Henderson and *G. hendersoni* Manning in the reduction of setae on the inner portions of the uropod but differs from both of these and other species of the genus in having two ventral carinae on each submedian tooth as well as a short, median postanal keel. As in *G. demanii*, a few proximal setae are present on the inner margin of the endopod in the new species. The carinate submedian teeth of the telson and the slender uropodal endopod will distinguish this species from the following new species, *G. crosnieri*.

Etymology.—The name is from the Latin, "bi", meaning "two," and "carina", meaning "keel," referring to the bicarinate ventral surface of the submedian teeth of the telson.

Distribution.—Known only from the type-locality, Nosy Bé, Madagascar.

Gonodactylus crosnieri, new species

Figure 15

Holotype.—1 ♀, 17.8; Banc de Pracel, western coast of Madagascar; 50 m; muddy sand; A. Crosnier; June 1959; USNM 124098.

Paratypes.—1 ♀, 19.3; Lagon de Mayotte Id., Comoro Islands; 50 m; A. Crosnier; August 1959; USNM 124099. 1 ♀, 13.5; same; MNHNP.

Description.—Anterior margins of rostral plate straight or with slight posterolateral slope; anterolateral angles acute but rounded.

Ocular scales small, erect.

Mandibular palp and 5 epipods present.

Lateral processes of sixth and seventh thoracic somites subtruncate, subequal in size or that of sixth somite slightly larger.

Carinae of sixth abdominal somite not markedly inflated, each with apical spinule.

Telson as long as broad, appearing elongate, with 2 pairs of slender, sharp, marginal teeth; lateral teeth not developed, lateral carina fusing with margin of intermediate tooth; dorsal surface of telson

with numerous spinules and tubercles; median carina flask shaped, tapering distally, with apical spine and subapical tubercles; 1–2 rows of spinules flank median carina, converging posteriorly; anterior submedian carinae with distal tubercle or spinule, flanked laterally and distally by spinules; anterior surface of telson with sharp tubercle on each side at level of intermediate carinae of sixth somite; carinae of marginal teeth each ornamented dorsally with spinules; numerous small submedian denticles and 2 sharp intermediate denticles, latter recessed anteriorly, present; ventral surface lacking distinct longitudinal carinae.

FIGURE 15.—*Gonodactylus crosnieri*, new species, female holotype, TL 17.8, Banc de Pracel: *a*, last abdominal somite, telson and uropod; *b*, uropod, ventral view.

Uropod abnormal in shape and setation; inner margin of exopod smooth, lacking setae, apex and outer margin of exopod setose; proximal segment of exopod with fixed ventrodistal spinule overhanging articulation of distal segment; endopod very broad, almost half or more than half as broad as telson, inner and outer margins convex, lacking setae, distolateral setae present; endopod with long, dorsal carina; spines of basal prolongation subequal in length.

COLOR.—Faded.

SIZE.—Females only known, TL 13.5–19.3. Other measurements of female holotype, TL 17.8: carapace length 3.6; fifth abdominal somite width 2.8; telson length 2.4, width 2.5.

DISCUSSION.—*G. crosnieri*, new species, resembles *G. demanii* Henderson, *G. hendersoni* Manning, and *G. bicarinatus*, new species, in dorsal armature of the telson but can be distinguished from these species by the absence of lateral teeth on the telson and by the broad uropodal endopod, which is half or more than half as broad as the telson

and which has smooth lateral margins and a distolateral fringe of setae. In the other three species the outer margin of the narrow endopod is fringed completely with setae. The new species lacks the longitudinal ventral carinae of the telson and the acute anterolateral angles of the rostral plate that are characteristic of *G. hendersoni*.

The broad uropodal endopod of this species will separate it from all other species in the genus.

Etymology.—The species is named for Alain Crosnier, who collected the species and made available for study most of the other material reported herein.

Distribution.—Known only from Madagascar and the Comoro Islands, in 50 m.

Gonodactylus demanii Henderson, 1893

Gonodactylus demani.—Gravier, 1935, p. 360, fig. 3.
Gonodactylus De Mani.—Dollfus, 1938, p. 213 [part].
Gonodactylus demanii.—Manning, 1967b, p. 8, fig. 3 [older references].

Illustration.—Manning, 1967b, fig. 3.

Previous records.—Fort Dauphin (Gravier, 1935); Maromandia (Dollfus, 1938).

Material.—1 broken ♂, CL 2.5; Tulear, Madagascar; from offshore reef; K. Boss; *Anton Bruun* Cruise 7, IIOE; USNM.

Diagnosis.—Anterolateral angles of rostral plate rounded or angled; ocular scales small; telson with 3 pairs of well-developed marginal teeth, submedians with movable apices; dorsal surface of telson with numerous spinules and tubercles; inner margin of uropodal exopod smooth, lacking setae; most of inner margin of uropodal endopod smooth, 1–5 proximal setae present; submedian teeth of telson each with 1 ventral carina.

Color.—Faded.

Discussion.—As shown by Manning (1967b), *G. demanii* is the western Indian Ocean counterpart of *G. hendersoni* Manning; it differs from the latter in having more rounded anterolateral angles on the rostral plate, 1–5 proximal setae on the uropodal endopod, and in lacking sharp ventral carinae on both the submedian and intermediate marginal teeth of the telson. *Gonodactylus crosnieri*, described above, differs from both *G. demanii* and *G. hendersoni* in having a broad, inflated uropodal endopod, with most of the inner and outer margins lacking setae but a few distal setae present.

Distribution.—Western Indian Ocean, from scattered localities between southern India, the Red Sea, and northern Moçambique (Manning, 1967b).

Gonodactylus lanchesteri Manning, 1967

?Gonodactylus De Mani var. *spinosus*.—Dollfus, 1938, p. 215, fig. 17.
Gonodactylus lanchesteri Manning, 1967b, p. 11, fig. 4 [older references].

ILLUSTRATION.—Manning, 1967b, fig. 4.

PREVIOUS RECORDS.—Comoro Islands (Manning, 1967b); ?Madagascar (Dollfus, 1938).

MATERIAL.—1 ♂, 25.6; Mayotte Id., Comoro Islands; intertidal zone; A. Crosnier; September 1959; USNM. 1 ♂, 27.8; 1 ♀, 29.9; Nosy Bé, Madagascar; in sandstone; A. Crosnier; 20 May 1958; USNM. 1 ♀, 15.5; same; A. Crosnier; 10 December 1958; MNHNP. 1 ♀, 24.0; same; intertidal zone; A. Crosnier; February 1962; MNHNP. 1 ♀, 25.4; same; from hard coral; A. G. Humes; 10 September 1964; USNM. 1 ♂, 27.3; Ambatoloka, Nosy Bé, Madagascar; Mme. Chavane; July 1958; USNM.

DIAGNOSIS.—Rostral plate rounded anterolaterally; ocular scales small; telson with 3 pairs of marginal teeth, submedians with movable apices; dorsal surface of telson with numerous spinules and tubercles; uropod with normal setation, margins of endopod, inner portion of proximal segment, and distal segment of exopod fringed with setae.

COLOR.—Faded in most specimens; in the male from the Comoro Islands there are median and lateral dark patches on the sixth thoracic somites, a dark patch on the first abdominal somite, traces of a dark band on each abdominal somite, and the ventral surface of the thorax and the copulatory tubes are dark.

DISCUSSION.—The uropod provided with a normal fringe of setae will immediately distinguish this species and *G. spinosus* Bigelow from *G. demanii* Henderson, *G. hendersoni* Manning, and *G. crosnieri* Manning. *Gonodactylus hendersoni* differs from *G. spinosus* in having the lateral teeth of the telson well developed, projecting, and in having the intermediate denticles recessed anteriorly.

All of the specimens reported herein have few, large tubercles on the telson.

DISTRIBUTION.—Western Indian Ocean from the Red Sea southward to South Africa (Manning, 1967b).

Gonodactylus segregatus Lanchester, 1903

FIGURE 16

Gonodactylus chiragra var. *segregatus* a+b Lanchester, 1903, p. 448, pl. 23 (figs. 6, 7, 7a).

PREVIOUS RECORDS.—None.

MATERIAL.—1 ♀, 22.9; Banc Vert, Madagascar; 14 m; A. Crosnier; January 1959; USNM. 1 ♀, 17.8; Mayotte Id., Comoro Islands; intertidal zone; A. Crosnier; September 1959; MNHNP.

DESCRIPTION.—Rostral plate with anterior margins transverse; anterolateral angles acute but not spiniform.

Ocular scales small, erect.

Mandibular palp and 5 epipods present.

Lateral process of sixth thoracic somite more truncate and larger than that of seventh somite.

Carinae of sixth abdominal somite almost tubular, not greatly inflated, each with apical spinule.

FIGURE 16.—*Gonodactylus segregatus* Lanchester, female, TL 22.9, Banc Vert: *a*, outline of lateral processes of sixth, seventh, and eighth thoracic somites, right side; *b*, last abdominal somite, telson, and uropod; *c*, uropod, ventral view.

Telson as broad as or broader than long, with 2 pairs of sharp marginal teeth, laterals distinct but not well developed, submedians with movable apices; dorsal surface of telson lacking tubercles and spinules except for apical armature of dorsal carinae; median carina tapering distally, with posterior spinule; accessory medians short, well developed, with posterior spinule, subapical tubercle present or

absent; accessory medians not fusing with median to form anchor; anterior submedians slender, with apical tubercle; an irregular U-shaped ridge, open anteriorly, extends posteriorly from midlength of telson between anterior submedian and intermediate carinae, across central carinae, to equivalent point on other side of telson; carinae of marginal teeth sharp, submedians divergent anteriorly; numerous small submedian denticles present; 2 intermediate denticles present, each sharp, anteriorly recessed; ventral surface of telson lacking sharp longitudinal carinae.

Endopod and expopod of uropod with normal complement of setae, some distal setae of endopod erect; endopod slender, tapered distally, with long dorsal carinae; proximal segment of exopod with slender, ventrodistal spine at articulation of distal segment; inner spine of basal prolongation shorter than outer.

Color.—Body light, with traces of darker pigment on dorsum; carapace, sixth thoracic somite, and first abdominal somite each with dark dorsal patch; sixth thoracic somite dark laterally; merus of claw with dark, dorsal patch.

Size.—Females only examined, TL 17.8–22.9. Lanchester's specimens were all small, TL 7.5–17.5. Other measurements of female, TL 22.9: carapace length 4.4; fifth abdominal somite width 3.1; telson length 2.8, width 2.8.

Discussion.—These two specimens correspond very closely with the account of the species given by Lanchester (1903); the telson ornamentation most closely resembles that recorded by Lanchester as "*segregatus* b."

Borradaile (1907) considers this species to be identical with *G. affinis* de Man, 1902, from Ternate, a form described by de Man as a variety of *G. chiragra*. Identification of *G. segregatus* with *G. affinis* must await direct comparison of type material or adequate redescription of both species based on type material.

The specimens recorded herein are similar to *G. choprai* Manning, 1967b, described from specimens taken in the northwestern Indian Ocean. *Gondoactylus choprai*, however, differs from all other species in the genus in lacking a fixed distoventral spine on the proximal segment of the uropodal exopod.

Distribution.—Central and western Indian Ocean, from the Comoro Islands, Madagascar, and from several localities in the Maldive Islands (Lanchester, 1903); shallow water to 35 fms.

Protosquilla Brooks, 1886

The genus *Protosquilla* includes the species assigned by Kemp (1913) to *Gonodactylus* Group III. Seréne (1952, 1954) commented on

the affinities of some of the species and listed the species known at that time.

Three species occur off Madagascar.

Protosquilla lenzi (Holthuis, 1941)

Gonodactylus glaber.—Kemp, 1913, p. 182, pl. 10 (fig. 121).—Serène, 1947, p. 385, fig. 1, pl. 2.

Gonodactylus lenzi Holthuis, 1941, p. 288 [new name for *G. glaber;* older references].—Tiwari and Biswas, 1952, p. 362.—Serène, 1954, pp. 6, 7, 10, 34, 52, 73, figs. 5–7, 11A–C, 13–12.—Manning, 1962, p. 11.—Ingle, 1963, p. 31, fig. 31.

Illustration.—Serène, 1947, fig. 1, pl. 2.

Previous record.—None.

Material.—1 ♀, 25.5; Nosy Bé; intertidal zone; Macnae; December 1958; USNM. 5 ♀, 25.8–30.0; same; sandstone; A. Crosnier; November 1961; MNHNP. 1 ♂, 25.9; Point Fièvre, Nosy Bé; 13°24′21″ S, 48°18′33″ E; J. Rudloe field no. Jr. 13; IIOE; 26 December 1963; USNM. 1 ♀, 32.3; same; 13°24.4′ S, 48°17.8′ E; intertidal mud flat, 50 yds. right of Centre d'Océanographie pier; J. Rudloe field no. 24A; IIOE; 4 January 1964; USNM. 1 ♀, 26.5; Ambatomboka Crater Point, Nosy Bé; 13°24′17″ S, 48°13′31″ E; from base of volcanic rocks; J. Rudloe field no. JR–23; IIOE; 3 January 1964; USNM.

Remarks.—These specimens agree well with Kemp's account of the species. There is some variation in the amount of pitting on the dorsal bosses of the telson; Seréne (1947) also commented on this variation.

The body is covered with light brown chromatophores aggregated in bands; darker bands or spots are present on the anterior and posterior third of the carapace and on the sixth and seventh thoracic and first abdominal somites. There is a characteristic dark spot laterally on the sixth thoracic somite.

Distribution.—Indo-West Pacific, from scattered localities between the eastern Indian Ocean and the Philippines. Shallow water.

Protosquilla pulchella (Miers, 1880)

Gonodactylus pulchellus.—Kemp, 1913, p. 177, pl. 10 (figs. 117–118).—Holthuis, 1941, p. 288, fig. 9b [older references].—Serène, 1954, p. 52 [listed].—Stephenson and McNeill, 1955, p. 252.—Ingle, 1963, p. 30, figs. 29, 49.

Illustration.—Kemp, 1913, pl. 10 (figs. 117, 118).

Previous record.—None.

Material.—2 ♂, 18.6–30.0; 1 ♀, 28.0; Nosy Bé; in sandstone; A. Crosnier; 20 May 1958; USNM. 1 ♂, 14.6; same; intertidal zone; A. Crosnier; September 1958; MNHNP. 1 ♂, 29.5; same; R. Legendre;

July 1959; USNM. 1 ♀, 30.4; same; A. Crosnier; January 1962; USNM. 1 ♀, 31.4; same; February 1962; MNHNP.

REMARKS.—These specimens agree well with Kemp's (1913) account of the species. All specimens have small posterolateral spines on the carinae or bosses of the sixth abdominal somite. The dark patches on the sixth thoracic somites may be well marked on the males but not on the females.

DISTRIBUTION.—Indo-West Pacific, from scattered localities between East Africa, the Red Sea, and Australia. Shallow water.

Protosquilla spinosissima (Pfeffer, 1888)

Gonodactylus spinosissimus.—Kemp, 1913, p. 191, pl. 10 (figs. 124–125).—Holthuis, 1941, p. 292, fig. 9c [with synonymy].—Serène, 1953, p. 507; 1954, pp. 6, 52 [listed].—Ingle, 1963, p. 31, fig. 30.

ILLUSTRATION.—Kemp, 1913, pl. 10 (figs. 124–125).

PREVIOUS RECORD.—None.

MATERIAL.—1 ♀, 12.8; Nosy Bé; intertidal zone; December 1958; MacNae; USNM.

DESCRIPTION.—Cornea flattened, faintly bilobed, set obliquely on stalk; ocular scales acute laterally; rostral plate trispinous, median spine longer than anterolaterals, extending to cornea, anterolateral spines extending just past base of eyestalk; anterior margin of carapace lateral to rostral plate slightly concave, angled anterolaterally; dactylus of claw with basal notch on outer margin; mandibular palp 2-segmented; first 4 abdominal somites smooth, margin of fourth angled posterolaterally; fifth somite smooth dorsally, with 3–4 longitudinal lateral carinae, posterolateral margin spined; sixth somite with anterior row of spinules, dorsal surface with 6 irregular groups of erect spines, each situated on low dorsal bosses indistinctly separated by shallow furrows; telson longer than broad, completely fused with sixth somite, ornamented dorsally with 3 bosses, median round, situated anteriorly, submedians oval, situated at and posterior to apex of median cleft; surface of telson covered with erect, slender spines, arising primarily from dorsal bosses and lateral margins; lateral spines arranged in 3 rows, outermost directed laterally, with 9–11 spines; posterior margin of telson with deep median cleft, lined with spines, and shallower submedian clefts; basal segment of uropod with 1–2 proximal dorsal spines; outer spines of basal prolongation of uropod longer than inner.

COLOR.—Body mottled brown; carapace and merus of claw with lighter transverse band; telson and uropods lighter than body, lacking definite pattern in preservative.

DISCUSSION.—This small specimen agrees in all details with the excellent account of the species given by Kemp (1913).

Protosquilla guerinii (White) is the only other species of *Protosquilla* known from the western Indian Ocean in which the telson is ornamented with long dorsal spines. That species, however, differs in having the fifth abdominal somite armed with 3–5 transverse rows of spinules, a row of spinules on the uropodal endopod, and the dorsal spines of the telson arranged in an entirely different pattern. The central spines on the telson of *P. guerinii* form a corona; the three fissures of the telson margin are almost equally deep and are lined with spinules. In addition, the dorsal spines on the telson of *P. guerinii* may be provided with fleshy tips that are absent in *P. spinosissima*.

Distribution.—Indo-West Pacific, from scattered localities between the western Indian Ocean and Japan. It has not been recorded previously from Madagascar. It usually is recorded from shallow water, on reefs, but Tattersall (1906) reported material from 45–50 fms off Ceylon.

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